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A Study of the Materials Used in the Construction of Modern Gymnasia.

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ABSTRACT

Objective information regarding materials used in constructing gymnasia is not readily available to architects and school people. What flooring, heating, ventilation, lighting, dressing facilities, seating, movable partitions, shower facilities for girls, shower heads, water treatment, and swimming pool construction materials are suited to particular designs, climatic conditions, and budgets? Most high school gymnasium construction budgets will not permit searching for the answers. In this study an effort was made to determine the materials, or systems of materials, that were used in selected gymnasia in all parts of the nation. The degree of success of these materials was basic to the study.

The gymnasia were selected in cooperation with the chief school officers of thirty-nine states. Questionnaires were sent to architects of the selected high school gymnasia and to the principals of the schools for which the gymnasia were built. Administrators' and architects' questionnaires representing 134 gymnasia were included in this study.

The heating systems were generally identified by the type of equipment used to distribute heat in the area. The fan coil heater was used more often than others to heat the main gymnasium areas. The finned-tubed convector was the most common method used to heat small rooms. Unit heater-ventilators were used to heat more than one-third of the dressing rooms.

Hot water was used more often than other heating mediums. Low cost gas-fired unit heaters were considered to have been satisfactory. Unit heater-ventilators were described as higher priced, efficient, and versatile heaters.

Windows were reported to require mechanical aid when employed as a means of ventilation. Wall mounted exhaust fans were reported to have been low priced means of ventilation. These units were reliable, but tended to pull hot air into the gymnasium, particularly in warmer climates. Ceiling exhaust fans were generally average in efficiency, but had a high noise level.

The ability of unit heater-ventilators to do the job of ventilation was debatable. These units provided outside air but apparently not in sufficient quantities to satisfy the conditions in some temperature ranges.

Incandescent lighting in main gymnasium areas was used more often than other types of lighting. Fluorescent lighting followed incandescent lighting in frequency of use except in schools with populations of 400-1,200 students. These reported mercury vapor lighting as their second choice. The mercury systems produced a bluish light. Some architects adjusted the light color by placing incandescent or fluorescent lamps into the system.

Of 134 gymnasia 101 used hard maple for their main gymnasium flooring. The degree of resilience of hardwood flooring depended on the system used to lay the flooring. Flooring systems involving resilience pads were used more often than others.

Troweled concrete dressing room floors were used more often than others. Troweled concrete was satisfactory; however, it was prone to be slippery when wet. Ceramic tile was the most popular shower room flooring. Generally, these floors were high priced but gave excellent service. The most successful shower room floors involved some metallic membrane and a fast run-off trough. Copper and lead were suggested as excellent metals for this purpose.

Two-tiered metal lockers for active physical education clothing storage were used more often than others. They were satisfactory, except their size was considered small. Full-length metal lockers received ratings of excellent. A general opinion of excellence was applied to the effectiveness of athletic clothing hanging racks.

Girls' individual shower stalls with associated dressing cubicles were reported more often than others. None of the shower heads reviewed proved satisfactory. Vandalism and leakage of shower heads were the problems experienced by most school administrators.

Of the basic four systems of spectator seating, all but one included versatile folding bleachers. The exception was the permanent seating arrangement which was a satisfactory system.

Opinions related to components of the ideal gymnasium showed large divergence. This was especially noticeable when opinions of school administrators were compared with opinions of architects.

The degree of serviceability of gymnasia included in this study was indicated by the fact that mean area dimensions were generally within recommended limits. Thus the dimensions could serve as a guide for planning future facilities within the normal high school gymnasium budget for the various sized schools.

CHAPTER I

INTRODUCTION

Recent emphasis on physical fitness and on the participation of every student in physical activity has met with varying degrees of interest and action. Educators for a long time have included in their objectives total development through the advancement of the mental, physical, and social aspects of children. Despite general agreement on the importance of good health and physical education programs, school authorities frequently are kept from achieving this goal. The reasons for this wandering, or downgrading of emphasis, are many and, quite often, complex; however, it is accepted by most educational authorities that lack of, or inadequate, facilities restrict any program of education. Inadequate facilities particularly deter the success of the lifetime sports program which is receiving national emphasis now.[1]

The basic facilities unit of any health and physical education program is the gymnasium. In the character and definition of this study, the gymnasium is a classroom, not just an athletic facility for basketball. It is suitable for lifetime sports participation, and it is a facility capable of satisfying the needs of community recreation.

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[1]Bud Wilkinson, "Lifetime Sports Foundation," Journal of Health, Physical Education, and Recreation, 36:32, 66-67, April, 1965.

If a structure is to fulfill its purpose, it must be well designed and constructed. The equipment and materials used in the construction must be durable; but, most of all, they must accomplish efficiently their designed purpose.

I. THE PROBLEM

Two questions were basic to the problem investigated in this study:

1. What materials and/or systems of materials were used in various areas of gymnasia located in all sections of the United States?

2. How well did the selected materials and/or systems of materials satisfy the conditions of their use in a specific gymnasium as determined by: (1) school administrators and (2) architects?

To approach the study of these questions the responses to the following questions were tabulated:

1. Into what cost categories did the various materials and/or systems of materials fit?

2. What were the problems in installation, maintenance, and operation?

3. What were the advantages and disadvantages of the various materials and/or systems of materials?

The following materials and/or systems of materials were included in this study: (1) heating, (2) ventilation, (3) air conditioning, (4) artificial lighting, (5) natural lighting, (6) flooring, (7) dressing facilities, (8) showering facilities, (9) main gymnasium seating, (10) operable partitions, (11) swimming pool tanks, and (12) swimming pool water conditioning.

Questions related to special problems were as follows:

1. What heating equipment was used in the various mean annual heating degree day zones?

2. What ventilation equipment was used in various mean annual cooling degree days zones?

3. What was the relative "hardness" of each type of flooring?

4. What was the relative slipperiness of each dressing room and shower room flooring?

5. What were the systems for laying flooring?

6. What was the frequency of movement of operable equipment?

7. What components were considered to have been necessary to an ideal gymnasium?

8. What components were considered to have been highly desirable but not required in an ideal gymnasium?

9. What components were considered not to have been needed in an ideal gymnasium?

10. What were the frequency and dimensions of common gymnasium areas?

II. DELIMITATIONS

Architects and engineers in cooperation with educators have the responsibility of designing gymnasia; however, as pointed out by an article in Building Construction, ". . . the school gymnasium is usually designed with the dollar in mind."[2] This statement carries

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[2] "High School Gyms: Cost is the Determinant," Building Construction, July, 1965, p. 47.

weight particularly with respect to high school gymnasia; therefore, this study has avoided the inclusion of problems which are primarily design considerations. It was recognized that the usability of many types of material items is determined by design patterns, and usability was an important part of this study; hence, design could not be ignored.

Construction and design standards of high school gymnasia are the responsibility of such regulating agencies as school boards, state departments of education, building authorities, and resident architects and engineers. This study has not considered construction or program standards in the basic problem. The emphasis has been placed on what has been accomplished in the construction and use of the selected gymnasia.

Deeper understanding of construction problems can be had by including the building contractors. This study has been national in scope; therefore, it would be an impossible task to contact such a large and variable group as building contractors. Construction problems were considered in general terms from the architect's viewpoint.

Since this was a study of gymnasia that are in use, costs of materials and maintenance were included in general terms only. Costs are continually rising, but they should remain within relative categories.

III. NEED FOR THE STUDY

Scott has defined the need for a functioning gymnasium planning group as follows:

> Teachers and administrators of health education and physical education, including athletics, recreation leaders, and others closely associated with these fields must of necessity increasingly involve themselves in the tasks associated with facilities

planning if their present and future programs are to achieve their goals. The facilities required for physical education and school recreation consume an amazingly large percentage of the total space and financial outlay for the educational program. The competition among the various educational disciplines for space and money at any of the several educational levels is tremendous. It seems clear, therefore, that unless all professional personnel connected with physical education and recreation units involve themselves in procuring and developing the necessary facilities for expanding their offerings, there is a real danger that the programs in these areas will be curtailed seriously both now and in the future.

A valid complaint is frequently voiced by teachers that it is extremely difficult, if not impossible, to become involved in planning facilities. It has been common practice for local planning groups, including architects, to ignore the instructors when facilities were being designed; however, school administrators, architects and engineers, as well as others in the planning groups, are coming to realize the imperative necessity of consulting those who will use the facilities. Such involvement is predicated upon the assumption that these users of facilities know what they need, are able to work harmoniously and intelligently as members of a planning team. School and public officials have the responsibility of selecting architects who have demonstrated the ability to seek out and be guided by the recommendations of those who are to use the facilities. At the same time, these officials have a right to expect teachers, administrators, and leaders to understand and be able to assume their proper roles in the planning of facilities.[3]

The study was undertaken initially because of the encouragement of Frank Brocato, who was at that time President of the Baton Rouge, Louisiana, Chapter of the American Institute of Architects. Brocato stated that this study can be useful to architects in two ways: (1) it will aid school people in "assuming their proper roles in the planning" of gymnasia, and (2) it will provide architects with a broad knowledge of what has been done and the successes achieved.

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[3]Harry A. Scott, "Facilities for the Future," Journal of Health, Physical Education and Recreation, 33:34-48, April, 1962.

IV. PROCEDURE

A proposal for the study was submitted to Brocato, and he recommended continuation of the plan with revisions. Brocato assigned the architectural firm of Evans and Glueck Architects to represent the Baton Rouge Chapter, A.I.A., in the project.

The primary instruments of the survey evolved into questionnaires (Appendices B and C), which were sent to designated architects and school principals. Evans and Glueck assumed primary responsibilities for revisions of the architect's questionnaire, and Payne Mahfouz, Principal of Opelousas High School, Opelousas, Louisiana, assumed primary responsibility for revisions of the principal's questionnaire.

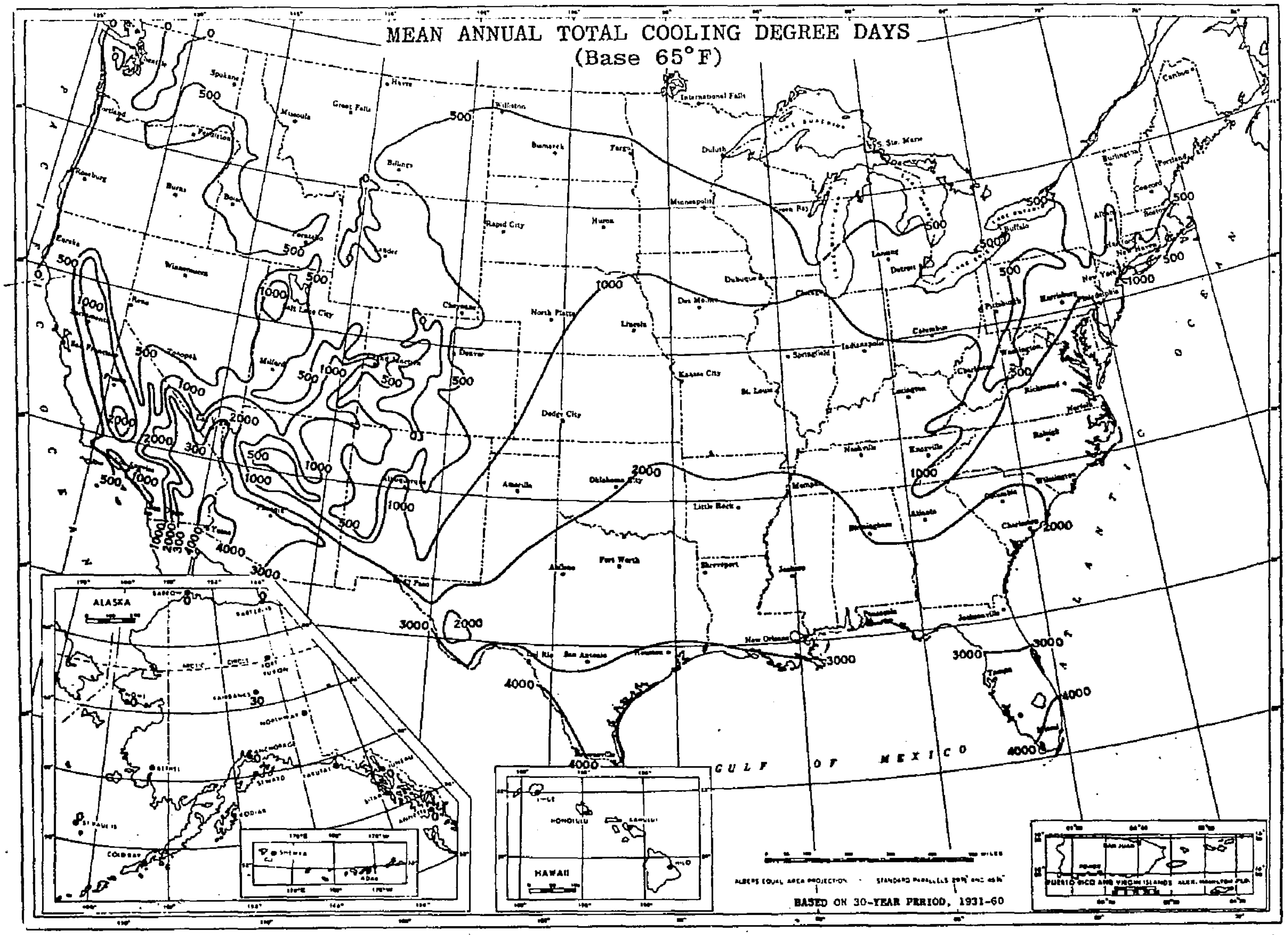
William J. Dodd, Louisiana State Superintendent of Public Education, was asked for aid. He provided the services of his office and commissioned that the study be published in bulletin form.

Superintendent Dodd wrote to the chief school officer of each state and United States possession requesting the assignment of a state coordinator to the project. All fifty chief state school officers and those of three of the four possessions assigned staff members to serve as coordinators (Appendix A). Each coordinator was asked to select six outstanding high school gymnasia located in his state. Each gymnasium was selected on the basis of its suitability for use in physical education classes, physical fitness programs, athletics, and lifetime sports. Each gymnasium had been in use at least three years and not more than ten years. Each coordinator had the opportunity to select two gymnasia serving high schools with a total population below 400, two serving high schools with a total population between 400 and 1,200, and two serving high schools with a total population above 1,200. Thirty-nine state coordinators responded with names and addresses of principals and architects of selected gymnasia. Hawaii and Guam made no selections because the coordinators believed the situations to be unusual, and that information concerning their structures would add little to the study. Virginia selected only gymnasia from the two larger population groups. North Dakota selected three gymnasia. The Panama Canal Zone had only one selection, and it was in use only one year.

General categories of heating requirements, cooling requirements, and moisture conditions were basic to the identification of gymnasia involved in this study. It is possible for gymnasia 3,000 miles apart to be within the same categories. Maps supplied by the United States Weather Bureau (Figures 1, 2, 3, pages 8, 9, 10) were used to record climatic locations of each school included in this study. When the mean temperature of a day is greater than 65^{o} Fahrenheit, there are as many cooling degree days as there are differences in temperature between the mean temperature for the day and 65^{o} Fahrenheit. The schools were located on the maps in the following zones of mean annual total cooling degree days: below 501, 501-1,000, 1,001-2,000, 2,001-3,000, above 3,000.

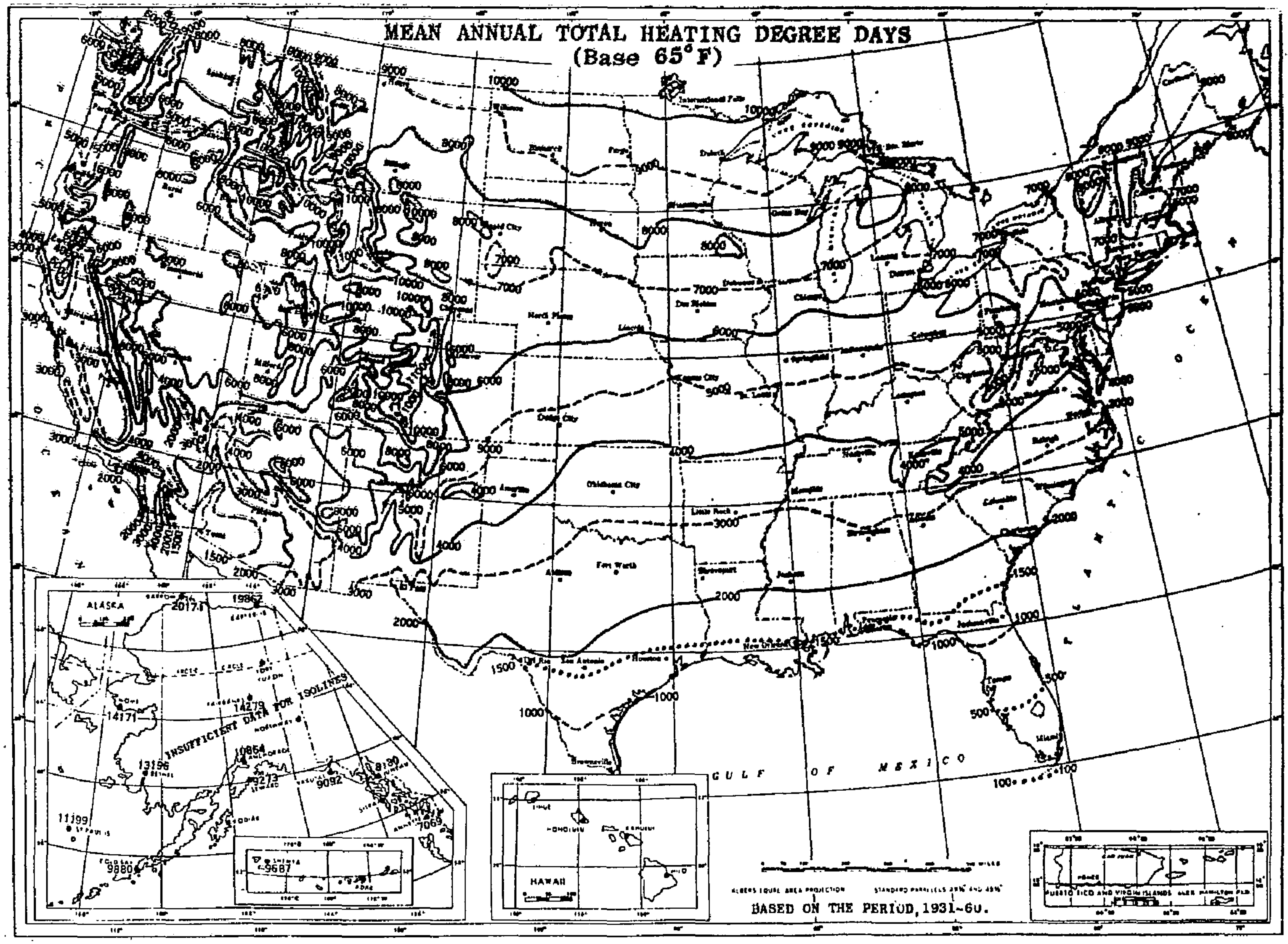
When a mean temperature of a day is less than 65^{o} Fahrenheit, there are as many heating degree days as there are degree differences in temperature between the mean temperature for the day and 65^{o} Fahrenheit. A second location was according to the mean annual total

FIGURE 1



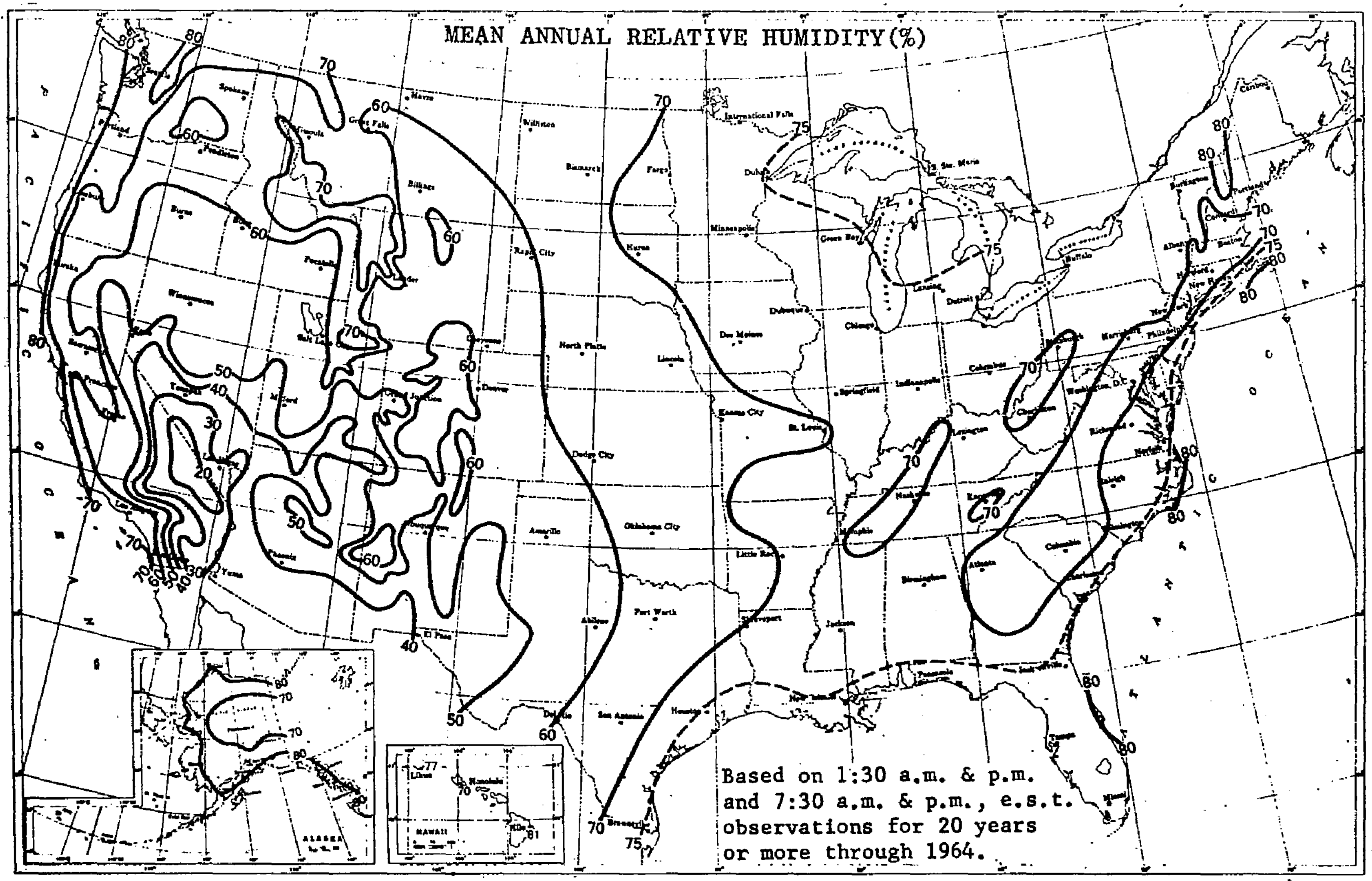
United States Weather Bureau, Climatological Data, National Summary Annual, 1965. Vol. 16. (Washington: Government Printing Office, 1965).

FIGURE 2



United States Weather Bureau, Climatological Data, National Summary Annual, 1965. Vol. 16. (Washington: Government Printing Office, 1965).

FIGURE 3



United States Weather Bureau, Climatological Data, National Summary Annual, 1965. Vol. 16. (Washington: Government Printing Office, 1965).

heating degree days, as follows: below 1,501, 1,501-3,000, 3,001-5,000, 5,001-7,000, 7,001-9,000, above 9,000.

Relative humidity is the amount of water vapor in the air compared with the amount required for saturation. If the air contains only one-half of the amount of water vapor that it can hold when saturated, the relative humidity is 50 per cent. A third location was according to the mean annual relative humidity, as follows: below 30, 30-40, 40-50, 50-60, 60-70, above 70.

Measurements of the main floor spaces, lobbies, dressing (locker) rooms, shower spaces, rest room areas, office space, and storage areas were taken from plan prints. Certain detail plans were redrawn and placed in the appropriate chapters to aid in defining the materials and/or systems of materials.

Data from the questionnaires and plan prints as well as information related to climatic locations were coded and punched on IBM cards for use in the IBM 1401 computer. A frequency distribution program was used. The print-outs were in the form of numbers and percentages, thus specific gymnasia lost their identity.

CHAPTER II

HEATING, VENTILATION AND AIR CONDITIONING

Heating, ventilation and air-conditioning of gymnasia involve procedures that are varied and complex. There is the necessity of heating, or cooling, a large area where strenuous physical activity is in progress and where relatively inactive spectators must be considered. Within the same building the dressing room area, demanding general warmth for unclothed, bathed bodies, is a place of high humidity. Offices, first aid rooms, and equipment storerooms, generally closely associated with the dressing rooms, require an atmosphere of low humidity and comfortable temperatures. Classrooms require an invigorating and yet comfortable atmosphere. Indoor natatoriums have extreme problems with condensation when kept at comfortable temperatures.

In a building such as a gymnasium where health considerations are paramount, it is logical that the definition of heating, ventilation and air-conditioning be in terms of health. Moyer and Fittz have written such a definition:

> Air conditioning is the application of methods of controlling the cleanliness, humidity, temperature, and movement of air in buildings to make the air comfortable and healthful and to obtain incidentally indoor conditions that are conducive to efficiency and happiness.[1]

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[1] James A. Moyer and Raymond V. Fittz, Air Conditioning (New York: McGraw-Hill Book Company, 1938), p. 1.

The term "heating" has been considered in relationship to the maintenance of a space at the temperature above that of its surroundings.[2] Generally, there was no attempt to control humidity, except in a few isolated cases, or movement of air except as it related to maintaining a desired room temperature. Where the heating system was associated with the ventilation equipment, clean air was achieved, but other types of heating provide little means for cleaning the air.

Ventilation was often associated with the heating equipment. Therefore the definition "supplying of atmospheric air, and the removal of inside air, in sufficient amounts to provide satisfactory living conditions,"[3] has been applied to this study. This has been termed "general ventilation" and refers to the general space being constantly flushed with fresh, outdoor air. Exhaust ventilation was found in most gymnasia either through movement of air because of temperature differentials or by mechanical means. Natural ventilation is effected by natural air movements through windows or roof openings.[4]

I. DEFINITION OF TERMS

1. Mean annual heating degree days (MAHDD). Mean annual heating degree days is computed from the base 65° Fahrenheit. When

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[2]Burgess H. Jennings and Samuel R. Lewis, Air Conditioning and Refrigeration (Scranton, Pa.: International Textbook Company, 1959), p. 1.

[3]Ibid.

[4]W. C. L. Hemeon, Plant and Process Ventilation (New York: The Industrial Press, 1955), p. 219.

the mean temperature of a day is less than 65° Fahrenheit, there are as many heating degree days as there are degrees difference in temperature between the mean temperature for the day and 65° Fahrenheit. For example, on a day when the mean temperature is 55°, there are 10 heating degree days on this day. The sum of the mean heating degree days for one year produces the mean annual heating degree days.

2. Mean annual cooling degree days (MACDD). Mean annual cooling degree days is computed from the base 65° Fahrenheit. There are as many cooling degree days as there are degrees difference in temperature between the mean temperature for the day and 65° Fahrenheit. The sum of the mean cooling degree days for one year produces the mean annual cooling degree days.

3. Gas-fired unit heaters. Gas-fired unit heaters contain the flame within the cabinet. Elements are heated by the flame, and a fan blows air by these elements into the space to be heated. The units may be wall hung or ceiling hung; they also may be placed on the floor. It is necessary to vent the units. They are usually controlled by thermostats located in the area to be heated, but they are sometimes controlled manually.[5]

4. Fan coil unit heaters. The fan coil unit heater is similar to the gas-fired unit heater. Instead of a flame within the unit, heat usually is brought to the unit by low temperature hot water or steam from a central hot water heater or a boiler. The unit does not require venting. The fan-propelled warmed air may be directed down

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[5]Julian M. Laub, Air Conditioning and Heating Practice (New York: Holt, Rinehart and Winston, 1963), pp. 416-417.

or at other angles to produce desired air flow. Air ducts may be attached to these units. Controls are usually thermostats.[6]

5. Unit heater-ventilators. Unit heater-ventilators are more complex than the fan coil unit heaters. They use low temperature hot water, or high temperature hot water, or steam. However, they have an air mixing chamber because they may draw outside air as well as recirculated inside air. The two previously described units recirculate inside air only. The unit heater-ventilator is especially suitable for use with air ducts, but it may be wall hung or ceiling hung.[7] It is a common practice to place them on the roofs of industrial buildings, but apparently this system was not favored in gymnasium construction. The controls usually involve several types of equipment in different combinations, that is, thermostatic, electronic, mechanical, pneumatic, hydraulic, and hydrostatic.

6. Electric-fired unit heaters. Electric-fired unit heaters are similar to the gas-fired unit heaters except that the heat is generated by electrical resistance coils. Some unit heater-ventilators also employ electricity as a source of heat.[8] They do not require venting, and they are adaptable to ducting. The controls are usually thermostatic and electronic.

7. Finned-tubed convectors. The principle of heated air movement

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[6]Burgess H. Jennings, Heating and Air Conditioning (Scranton, Pa., International Textbook Company, 1956), p. 285.

[7]Ibid., pp. 282-283.

[8]Heating Ventilating Air Conditioning Guide, 1958 (New York: American Society of Heating and Air Conditioning Engineers, Inc., Vol. 36, 1958), p. 1048.

is applied in the finned-tubed convectors. Air flows from the bottom of an enclosure, past the heater fins, and out the vented top of the enclosure.[9] Hydrostatic controls are important to this system; that is, the flow of hot water or steam must be controlled.

8. Radiators. The radiator is like the convector except that there is no enclosure, or the enclosure does not provide for air circulation from the bottom through the top of the enclosure. The enclosures are vented at the top, and the heat is transmitted into the space by radiation.[10] Like the convector, hydrostatic controls are important to successful operation.

II. DATA CONTROLS

The distribution of the reporting schools and architects was consistent over most of the data control factors; that is, school population groups, mean annual heating degree days zones, and mean annual cooling degree days zones. The distribution according to school population groups was as follows: (1) below 400 students, 47 (35 per cent) of the reporting schools and architects; (2) from 400 to 1,200 students, 47 (35 per cent) of the reporting schools and architects; and (3) above 1,200 students, 40 (30 per cent) of the reporting schools and architects. School population groups were the first and most important of the data controls throughout the study.

The distribution of the schools within the zones of mean annual heating degree days given was as follows: (1) below 1,501, 3 (2.3

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[9]T. Napier Adlam, Radiant Heating (New York: The Industrial Press, 1947), p. 4.

[10]Ibid.

per cent); (2) 1,501 - 3,000, 19 (14.2 per cent); (3) 3,001 - 5,000, 31 (23.1 per cent); (4) 5,001 - 7,000, 46 (34.3 per cent); (5) 7,001 - 9,000, 26 (19.4 per cent); and (6) above 9,000, 9 (6.7 per cent). Mean annual heating degree days zones were used as data controls in the study of heating data.

The distribution for the mean annual cooling degree days followed the same pattern as shown above. Expressed in per cent of reporting schools and architects, the distribution was as follows: (1) below 501, 34 (25.4 per cent); (2) 501 - 1,000, 39 (29.1 per cent); (3) 1,001 - 2,000, 34 (25.4 per cent); (4) 2,001 - 3,000, 25 (18.7 per cent); and (5) above 3,000, 2 (1.4 per cent). Mean annual cooling degree days zones were used as data controls in the study of ventilation and air conditioning.

The distribution of reporting schools and architects according to mean annual relative humidity followed the pattern shown in Figure 3, page 10, where huge land areas were enclosed by the 60-and-above mean annual relative humidity iso-lines. The distribution expressed in per cent of reporting schools and architects was as follows: (1) below 30, 0 per cent; (2) 30 - 40, 0 per cent; (3) 40 - 50, 1 (.7 per cent); (4) 50 - 60, 3, (2.3 per cent); (5) 60 - 70, 29, (21.6 per cent); and (6) above 70, 101 (75.4 per cent). Because of this uneven distribution and the lack of a reasonable number of reporting schools within several of the zones, mean annual relative humidity was not used as a data control factor.

A close relationship of the zones of mean annual heating degree days and mean annual cooling degree days is indicated in Table 1. The entries are concentrated along the diagonal from the upper

TABLE I

SCATTERGRAM OF THE SCHOOLS WITHIN
MEAN ANNUAL HEATING DEGREE DAY ZONES AND
MEAN ANNUAL COOLING DEGREE DAY ZONES

Mean Annual Heating Degree Days

Mean Annual Cooling Degree Days

	Below 1,501	1,501 3,000	3,001 5,000	5,001 7,000	7,001 9,000	Above 9,000
Above 3,000	11111					
3,000 2,001	11	11111 11111 11111 1111	1111			
2,000 1,001		11	11111111 11111111 11111111 1111	11111111 1		
1,000 501			111	11111111 11111111 11111111 11	11111111 1	
Below 501			11	111111	11111 11111 1111	11111

left-hand to the lower right-hand section of the diagram. There was relatively little "scatter," indicating that the zone requiring the most heat also required the least cooling and the zone requiring the least heat required the most cooling. On this basis it was determined that a study of the cross relationships of heating and mean annual cooling days, or cooling and mean annual heating days, would not contribute substantially to the study.[11]

III. HEATING

Gymnasium heating systems may be classified by several different methods: (1) by the type of fuel, gas (natural), oil, coal, electricity; (2) by the method of delivering the heat, warm air, steam, hot water, electricity; (3) by the type of heating element, panel, radiator, convector, warm air, electrical resistance; (4) by the system of heating delivery, gravity, forced air unit system, forced air central system, radiator, convectors, piped warm air. Heating systems are identified by The American Society of Heating, Refrigeration and Air Conditioning Engineers, Incorporated, as follows: warm air heating systems, steam heating systems, high temperature water systems, electric heating, and panel heating.[12] The ASHRAE also uses district heating as a classification for heating systems.[13]

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[11] Henry E. Garrett, Statistics in Psychology and Education (fifth edition; New York: David McKay Co., Inc., 1958), p. 135.

[12] ASHRAE Guide and Data Book, 1962 Applications (New York: American Society on Heating, Refrigeration, and Air-Conditioning Engineers, Inc., 1962), pp. 61-168.

[13] Ibid., p. 111.

When heating and ventilation systems were closely allied and there were equipment and procedures for controlling air temperature, cleanliness, and movement, the term "air conditioning" was applied. Relatively little air conditioning of the traditional type was reported. During winter there was generally no attempt to control humidity. The more sophisticated air-conditioning systems of cooling and heating control with humidity maintained at a fixed level during the entire year, or fixed humidity level during the summer and a lower humidity level during the winter, have been reported and have been considered individually according to the type of system.

Because most of the architects used the method of heat delivery within an area to describe the heating systems, the following classifications were used in the study: (1) gas-fired unit heaters, (2) fan coil convectors, (3) unit heater-ventilators (hot water), (4) unit heater-ventilators (steam), (5) electric-fired unit heaters, (6) finned-tubed convectors, and (7) radiators. There was only one report of panel heating; its application will be discussed later. High temperature hot water systems were not reported by the participants in this study, but heating with high temperature hot water is considered important; therefore, it was discussed. Two reports of warm air systems formed a basis for a discussion later in the chapter.

Hot water systems were reported more often than other heating systems, as is indicated by Table II. The fan coil unit heater method of heat delivery was used in 47 per cent of the main gymnasium areas and in 34.4 per cent of the dressing rooms. Because of the adaptability to ducting, the unit heater-ventilator (hot water and

TABLE II

TYPES OF HEATING SYSTEMS
USED IN THE DRESSING ROOMS, SMALL ROOMS,
AND MAIN GYMNASIUM AREAS OF 134 GYMNASIA

AREA	DRESSING ROOMS	SMALL ROOMS	MAIN GYM
TYPES OF SYSTEMS	Per Cent	Per Cent	Per Cent
Gas-fired unit heater	16.4	11.3	10.5
Fan coil unit heater	34.4	8.6	47.0
Unit heater-ventilator (hot water)	35.8	4.3	21.6
Unit heater-ventilator (steam)	6.7	8.6	12.7
Electric-fired unit heater	2.3	2.7	7.5
Finned-tube convector	3.7	44.5	0
Radiators	0	18.6	.7
Others	.7	1.4	0
No answer	0	47.8	0

steam) delivered heat to 42.5 per cent of the dressing rooms. Wall mounted finned-tubed convectors served 44.5 per cent of the small rooms.

Heating in the Main Gymnasium Area

Because of the economics of providing an integrated heating system within a building, heating of the main gymnasium area established the pattern for heating the dressing rooms and small rooms within a gymnasium. It was found that 45, (32.8 per cent), of the gymnasia were a part of the classroom complex; thus, many of the construction decisions related the gymnasia to the other portions of the schools. Information concerning this influence was limited; therefore, gymnasium heating was studied as a unit within itself.

Information in Table II confirms that the patterns for heating the main gymnasium area, the dressing rooms, and small rooms were similar; however, the desirability of area control caused a variance in the percentage of use of the different portions of the systems. The adaptability and efficiency of performance of specific systems had some influence on the change in percentage of use of these systems and completely eliminated, except as auxiliary units, the use of the finned-tubed convectors. Also, only one radiator system was reported for heating of the main gymnasium areas.

National distribution of main gymnasium heating systems. The gas-fired unit heater was popular in warm climates; however, it was used by both large and small schools in the highest MAHDD zone, as is shown in Table III. Schools in two of the middle MAHDD zones did not report this system of heating the main gymnasium areas.

TABLE III

HEATING SYSTEMS USED IN THE MAIN GYMNASIUM AREAS
ARRANGED ACCORDING TO MEAN ANNUAL HEATING DEGREE DAYS
AND SCHOOL POPULATION GROUPS

SCHOOL POPULATION	Below 400 (47 Schools)						400 - 1200 (47 Schools)						Above 1200 (40 Schools)					
MEAN ANNUAL HEATING DEGREE DAYS	below 1,501	1,501 3,000	3,001 5,000	5,001 7,000	7,001 9,000	above 9,000	below 1,501	1,501 3,000	3,001 5,000	5,001 7,000	7,001 9,000	above 9,000	below 1,501	1,501 3,000	3,001 5,000	5,001 7,000	7,001 9,000	above 9,000
TYPES OF SYSTEMS	Per Cent						Per Cent						Per Cent					
Gas-fired unit heater		45.6	23.1			33.3		20.0	7.1				100		9.1			25.0
Fan coil unit heater		27.2	38.5	64.1				80.0	64.1	47.0	45.6			66.7	63.7	58.3		
Unit heater-ventilator (hot water)			15.3	14.4	40.0	66.7			14.4	41.2	27.2			33.3	27.2	16.7		
Unit heater-ventilator (steam)		27.2			60.0				14.4	5.9	18.1				16.	16.7	66.7	50.0
Electric-fired unit heater			23.1	21.5						5.9	9.1					8.3	33.3	25.0

The fan coil heaters were reported more often in the middle MAHDD zone by schools in all three population groups. Sixty-four per cent of the small schools in 5,001 - 7,000 used the fan coil heaters. More than 40 per cent of the schools in the middle and large population groups located in the middle MAHDD zones reported fan coil heaters in the main gymnasium areas.

Unit heater-ventilator systems were reported in almost all MAHDD zones by schools of each of the three population groups. A larger per cent of small schools in the colder zones reported hot water unit heater-ventilators. Small schools in only two MAHDD zones reported steam unit heater-ventilators in the main gymnasium areas. Schools in the middle population group and in the middle MAHDD zones reported both hot water and steam unit heater-ventilators. Hot water unit heater-ventilators were reported by schools with student population above 1,200 in the middle MAHDD zones, whereas steam systems were reported in the colder zones.

Electric-fired unit heaters for heating main gymnasium areas were reported to have been used by schools in most of the MAHDD zones; the exceptions were the zones below 1,501 and 1,501 - 3,000. The small schools in only two middle MAHDD zones reported these heaters in use. The larger schools in the colder zones used the electric-fired unit heaters.

Architects' responses to questionnaires. Architects indicated generally that gas-fired unit heaters created no problems when being installed, as Table IV indicated. However, they varied in the estimation of cost of installation and cost of units: 66.7 per cent indicated low and 33.3 per cent reported average.

TABLE IV

ARCHITECTS' RESPONSES TO QUESTIONS
REGARDING HEATING SYSTEMS USED
IN 134 MAIN GYMNASIUM AREAS

TYPES OF SYSTEMS	COST OF UNIT			COST OF INSTALLATION			INSTALLATION PROBLEMS		
	Per Cent			Per Cent			Per Cent		
	low	average	high	low	average	high	simple	average	complex
Gas-fired unit heater	66.7	33.3	0	66.7	33.3	0	91.7	8.3	0
Fan coil unit heater	14.3	85.7	0	18.2	81.8	0	50.0	50.0	0
Unit heater-ventilator (hot water)	14.2	85.7	14.2	17.6	70.6	11.8	76.5	23.5	0
Unit heater-ventilator (steam)	33.3	66.7	0	33.3	66.7	0	50.0	50.0	0
Electric-fired unit heater	14.3	85.7	0	0	100	0	71.4	28.6	0

Architects who designed the gymnasia found that the fan coil heaters were average in equipment cost and cost of installation. Opinions differed on the problems experienced during the installation of the equipment. One-half of the respondents expressed the experience of relatively few problems and one-half considered that the problems encountered were average for heating equipment installations in the main gymnasium areas.

Cost of hot water and steam unit heater-ventilators was considered as average by most of the architects; however, some stated that the cost of hot water systems was high. For individual gymnasia not included in the school heating systems, installing a central heating plant increased the relative costs. Some of the architects also reported the cost of installing hot water systems to have been high. Relatively few problems were experienced when installing hot water or steam systems in the main gymnasium areas.

Architects who installed the electric-fired unit heaters in gymnasia considered the cost of the equipment and the cost of the installation to have been average. Most architects experienced few problems when installing the equipment.

School administrators' responses to questionnaires. School people reported satisfaction with the gas-fired unit heaters as used in main gymnasium areas, as the information in Table V shows. There were two points of deviation from this satisfactory response: 7.7 per cent of the school administrators reported a high cost of operation and 8.3 per cent of the users indicated that the cost of maintenance was high.

TABLE V

SCHOOL ADMINISTRATORS' RESPONSES TO QUESTIONS REGARDING HEATING SYSTEMS USED IN 134 MAIN GYMNASIUM AREAS

TYPES OF SYSTEMS	DOES JOB			OUT OF USE DUE TO BREAKDOWN			COST OF MAINTENANCE			DIFFICULTY OF MAINTENANCE			OUT OF USE DUE TO MAINTENANCE			COST OF OPERATION			EASE OF OPERATION		
	Per Cent			Per Cent			Per Cent			Per Cent			Per Cent			Per Cent			Per Cent		
	poor	average	excellent	little	average	large	low	average	high	simple	average	complex	little	average	large	low	average	high	simple	average	complex
Gas-fired unit heater	0.	28.6	71.4	78.6	21.4	0	50.0	41.7	8.3	64.3	35.7	0	85.7	14.3	0	7.7	84.6	7.7	76.9	23.1	0
Fan coil unit heater	4.4	30.4	65.2	87.0	4.3	8.7	36.4	59.1	4.5	54.5	45.5	0	81.9	13.6	4.5	21.7	78.6	0	61.9	38.1	0
Unit heater-ventilator (hot water)	7.2	35.7	57.1	86.6	6.7	6.7	35.7	57.1	7.2	62.5	31.3	6.2	86.7	13.6	0	17.6	76.5	5.9	66.7	33.3	0
Unit heater-ventilator (steam)	0	11.1	88.9	75.0	25.0	0	66.7	33.3	0	42.9	42.9	14.2	87.5	12.5	0	25.0	62.5	12.5	50.0	50.0	0
Electric-fired unit heater	0	60.0	40.0	100	0	0	60.0	20.0	20.0	60.0	20.0	20.0	100	0	0	20.0	60.0	20.0	60.0	0	40.0

A majority of the school administrators who used the fan coil heater reported them to have been excellent; however, 4.4 per cent experienced poor performance of the units. A small percentage of the users of the fan coil heaters reported large amounts of time lost to breakdowns. Most school administrators reported that cost of maintenance was average. The equipment was generally reported to have been out of use for maintenance for small amounts of time. The cost of operating these heaters was found to have been average. The ease of operation was reported by the administrators as simple.

School people who used unit heater-ventilators considered both the hot water and steam type to have been excellent in performing the task of heating the main gymnasium area. Neither the hot water nor the steam system users experienced problems related to loss of time due to breakdown of equipment, although 6.7 per cent indicated large amounts of breakdown time. Problems of maintaining both hot water and steam systems were reported by a small percentage of the school administrators.

Hot water unit heater-ventilators were considered to have had high operating cost by 5.9 per cent of the administrators, while 12.5 per cent of those using steam unit heater-ventilators considered this system to have had high operating cost. Hot water systems were considered to have been simple to operate. The users of the steam unit heater-ventilators believed that the operation of these units was somewhat more complex.

The reliability of the electric-fired unit heaters was indicated by 100 per cent of its users reporting little loss of operating time caused by breakdown or maintenance. Forty per cent of the school administrators reported excellent heating by the units.

Gas-fired unit heaters. The advantage of using gas-fired unit heaters, most often mentioned by architects who installed the equipment, was efficiency of heat production with low maintenance requirement. The second reason for using the units was the production of good circulation. School administrators agreed that these units provided good air circulation.

Other reasons for using gas-fired unit heaters in main gymnasium areas were: (1) absence of mechanical room requirement, (2) ease in control, (3) absence of freezing problem or recirculation problems, and (4) appearance that is neat and compact.

Noise production and difficulty in servicing because of location were listed as problems by architects who installed gas-fired unit heaters. The most common problems experienced by users of this equipment were: (1) susceptible to tampering and (2) poor ventilation.

The reasons given by Severns and Fellows for using direct-fired unit heaters, such as the gas-fired unit heater, to heat large space areas are low first cost and the small amount of space required.[14]

Fan coil unit heaters. Fan coil unit heaters require a central source of heat. Heat is carried to the fan coil unit by the heated medium such as water or steam. An architect in Alaska reported the use of glycol. Electric resistance heating elements were used also

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[14]William H. Severns and Julian R. Fellows, Air Conditioning and Refrigeration (New York: John Wiley and Sons, Inc., 1958), p. 357.

in this type of system. Thus, the fan coil heating system easily fits into the heating system of the entire school plant.

Architects listed "easily controlled, good circulation" as the first reason for installing fan coil heaters. Other advantages were listed as follows: (1) gas ventilation problems few, (2) operation efficient and safe, (3) duct work not required, and (4) maintenance requirements low.

School administrators indicated the following advantages in using fan coil heaters: (1) good circulation, (2) efficient and safe operation, (3) low maintenance, (4) little interference with school activities, and (5) easy to control.

The possibility of high noise level was listed by architects as the first detracting factor in the use of fan coil heaters. Higher initial cost was the largest disadvantage indicated by the architects. Other problem areas found when using fan coil heaters were: (1) qualified personnel needed to operate and maintain, (2) poor circulation, and (3) large amounts of space needed when considering the water heater or boiler system.

Fifty per cent of the school administrators indicated that poor ventilation was the greatest problem when using fan coil heaters. Noise, poor circulation and difficulty in servicing because of location were also specified by the administrators as being problem factors.

Patel and Mehta wrote that fan coil heaters are suitable in the following circumstances: (1) areas requiring larger heating capacities than those handled by gravity units, (2) areas requiring all possible floor space, and (3) areas requiring spot heating such as vestibules, corridors and exterior doors. They also suggest that propeller fan units be used for delivery applications of moderate requirements and that fan units be used where the heating requirements or space volume is large with operation against static resistance.[15]

Unit heater-ventilators. Like the fan coil unit heaters, the unit heater-ventilators require a central source of heat such as hot water or steam. Electric resistance heating elements were used also in this type of system. Unit heater-ventilators have an ability to use outside air in the desired proportions, to recirculate inside air, and to clean the air.

There are four principal types of heating related to unit heater-ventilators: (1) hot water, (2) steam, (3) electricity, and (4) high temperature hot water. "Steam heating systems may be classified according to any one of, or combination of, the following features: (1) piping arrangements, (2) pressure or vacuum conditions obtained in operations, and (3) method of returning condensate to the boiler."[16] For the purposes of this study all steam systems were included in one group. Electric systems and high temperature hot water systems will be discussed in a later section of the study.

Architects listed the following as advantages experienced in installing hot water unit heater-ventilators: (1) easily controlled, good circulation, (2) efficient and safe operation, (3) no additional

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[15] O. M. Patel and A. K. Mehta, Principles of Air Conditioning in Theory and Practice (Bombay, India: Allied Publishers Private Limited, 1963), p. 162.

[16] ASHRAE Guide and Data Book, 1962 Application, op. cit., p. 83.

ventilation problems, (4) blower system for summer ventilation using outdoor air, and (4) adaptable to all climatic conditions. Only two favorable characteristics were reported by the school administrators: (1) efficient and safe operation and (2) easily controlled, good circulation.

Advantages found in the operation of unit heater-ventilators when heating large areas were explained by Patel and Mehta. The automatic control must provide the control in the following stages:

> 1. During warm-up stage, outdoor dampers must be 100% closed and indoor dampers 100% opened and full heat must be supplied to heater unit until the room air attains the desired temperature.
> 2. As the room temperature rises to the desired temperature, the thermostat must come into action and control the outdoor damper according to the cycle of control used. If the room temperature continues to rise, the heat supply to heater is throttled.
> 3. When the room temperature is above the normal, outdoor is shut off. Thus cool air is discharged into the room, the discharge temperature being prevented from falling below say 55°F. by the air stream thermostat. To provide the above three stages of controlled working, any one of the following basic cycles may be used:
> (a) Except during first warming stage, 100% outdoor air is admitted at all times.
> (b) A minimum amount of outdoor air, normally 25 to 50% is admitted during the second state. This percentage is increased to 100% for the third stage if necessary.
> (c) Except during the first stage of warming, the two dampers are so regulated as to maintain say a fixed temperature of 55°F. by the air stream thermostat.[17]

Fifty per cent of the architects who installed hot water unit heater-ventilators in colder climates experienced some difficulties in exhausting indoor air for large crowds in below-zero (Fahrenheit) weather. Other disadvantages of the system listed by architects were: (1) possibility of high noise factor, (2) qualified personnel required to maintain equipment, (3) susceptibility to damage by tampering, and

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[17] Patel and Mehta, _op. cit._, pp. 160-161.

(4) good summer ventilation because blower system uses outside air. All of the school administrators indicated that, easily controlled circulation was the main characteristic of the units.

Disadvantages found in using the steam unit heater-ventilators indicated by architects who installed them were: (1) difficulty experienced in exhausting for large crowds in below-zero (Fahrenheit) weather, (2) qualified personnel needed to maintain equipment, and (3) space requirements large. School administrators indicated that difficulty of servicing and noise level were the main problems experienced with the units. Patel and Mehta suggested that cold downdrafts at windows could be a problem if preventive measures were not exercised.[18]

Electric-fired unit heaters. There were two types of electric-fired unit heaters employed in heating gymnasia. One was the fan coil type that recirculated indoor air. The other was the heater-ventilator type that used outside air and recirculated inside air. Because several of the reports on the use of electric-fired unit heaters did not distinguish between the two systems, this study has included all reported units as electric-fired unit heaters.

Architects reported that reliability was the prime reason for selecting electric-fired unit heaters for main gymnasium area heaters. Other advantages found when using the heaters were: (1) clean, even heat, (2) easy to install, (3) simple to control, and (4) a minimum of space required.

School administrators agreed with architects that reliability

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[18] Ibid.

of electric-fired heaters was the outstanding advantage. They also reported that units were easily controlled and provided good circulation.

Architects reported no disadvantages of electric-fired unit heaters. However, some school people believed the cost of operation to have been high. They also reported that poor ventilation occurred in some of the main gymnasium areas, especially in colder climates.

Heating Dressing Rooms

As previously stated, the pattern of heating was generally established by the system used in the main gymnasium areas. This portion of the study was based on the deviations in the percentages related to the use of the various systems and the differences in success or failure of the systems within dressing room areas of the gymnasia.

National distribution of dressing room heating systems.

Gas-fired unit heaters in dressing rooms were popular in small schools of the warmer climates according to Table VI. Schools with student populations of 400 - 1,200 reported that gas-fired unit heaters were used in four of the six MAHDD zones. Schools with a population above 1,200 students used the units in only two MAHDD zones.

Fan coil unit heaters in dressing rooms were distributed over the entire MAHDD range used in this study. These heaters were reported to have been used by small schools in five of the six MAHDD zones reported the installation of these heaters in dressing

TABLE VI

HEATING SYSTEMS USED IN DRESSING ROOMS
ARRANGED ACCORDING TO MEAN ANNUAL HEATING DEGREE DAYS
AND SCHOOL POPULATION GROUPS

SCHOOL POPULATION	Below 400 (47 Schools)						400 - 1200 (47 Schools)						Above 1200 (40 Schools)					
MEAN ANNUAL HEATING DEGREE DAYS	below 1,501	1,501 3,000	3,001 5,000	5,001 7,000	7,001 9,000	above 9,000	below 1,501	1,501 3,000	3,001 5,000	5,001 7,000	7,001 9,000	above 9,000	below 1,501	1,501 3,000	3,001 5,000	5,001 7,000	7,001 9,000	above 9,000
TYPES OF SYSTEMS	Per Cent						Per Cent						Per Cent					
Gas-fired unit heater		53.8	23.1					28.6	22.2	15.0	18.2				20.0			20.0
Fan coil unit heater		30.8	30.8	20.0	25.0	75.0		42.8	44.5	20.0	54.5		50.0	100	50.0	30.0	25.0	
Unit heater-ventilator (hot water)		15.4	23.1	50.0	75.0	25.0				55.0	18.2		50.0		20.0	60.0	62.5	20.0
Unit heater-ventilator (steam)			15.3	10.0					22.2	5.0						10.0		40.0
Electric-fired unit heater			7.7	10.0					11.1	5.0	9.1						12.5	20.0
Finned-tube convectors				10.0				28.6							10.0			

rooms; unlike the small schools, the exception was a school in the coldest zone.

Hot water unit heater-ventilators were distributed over the entire MAHDD range and were reported to have been used by the small and large schools in five of six MAHDD zones. The units were not in large schools in the 1,501 - 3,000 zone. Schools with a student population of 400 - 1,200 reported hot water unit heater-ventilators in the dressing rooms in only two MAHDD zones. Approximately 50 per cent of the schools located in colder zones reported heating dressing rooms with hot water unit heater-ventilators.

Schools in each of the population groups reported steam unit heater-ventilator dressing room heating in two of the MAHDD zones. Small and middle-sized schools reported the units in the middle MAHDD zones. Large schools indicated the heaters were being used in one middle MAHDD zone and in the zone requiring the greatest amount of heating.

Small and middle-sized schools in the middle MAHDD zones reported electric-fired unit heater dressing room heating. Schools with a population above 1,200 reported the heaters in operation in the two coldest zones.

Finned-tubed convectors as heaters of dressing rooms were reported to have been in use in three middle MAHDD zones. Schools in each of the population groups reported the heaters in only one zone each.

<u>Architects' responses to questionnaires</u>. Architects who

installed gas-fired unit heaters in dressing rooms considered the cost of the equipment as low, as reported in Table VII. Problems experienced during installation of units were considered to be simple. Opinions concerning the cost of installation were almost equally divided between low and average.

Architects reported that the cost of using fan coil heaters in dressing rooms was average both for the equipment itself and for installing the equipment, but 10 per cent of the architects believed that the cost of the equipment was high. Similarly, 5 per cent of the architects reported the cost of installation was high. Opinions of the problems experienced when installing the fan coil heaters in dressing rooms were divided evenly between simple and average.

Architects generally agreed that the cost of hot water and steam unit heater-ventilators was average, as was the cost of installing the equipment. Some architects, 8.3 per cent, found the cost of the hot water unit heater-ventilators to have been high and 4 per cent reported the installation cost to have been high. Most architects installing hot water systems experienced average problems during installation. Architects who installed steam systems reported simple installation problems.

All of the architects reported the cost of equipment and the cost of installation of electric-fired unit heaters in dressing rooms were average. All reported that there were few installation problems. Thus, there was complete agreement among the architects who installed electric-fired unit heaters.

TABLE VII

ARCHITECTS' RESPONSES TO QUESTIONS
REGARDING HEATING SYSTEMS USED IN THE
GYMNASIUM DRESSING ROOMS OF 134 SCHOOLS

TYPES OF UNIT	COST OF UNIT			COST OF INSTALLATION			INSTALLATION PROBLEMS		
	Per Cent			Per Cent			Per Cent		
	low	average	high	low	average	high	simple	average	complex
Gas-fired unit heater	80.0	20.0	0	55.6	44.4	0	80.0	20.0	0
Fan coil unit heater	10.0	80.0	10.0	10.0	85.0	5.0	50.0	50.0	0
Unit heater-ventilator (hot water)	8.3	83.4	8.3	12.0	84.0	4.0	43.5	56.5	0
Unit heater-ventilator (steam)	0	100	0	0	100	0	75.0	25.0	0
Electric-fired unit heater	0	100	0	0	100	0	100	0	0
Finned-tube convector	66.7	33.3	0	33.3	66.7	0	66.7	0	33.3

The cost of finned-tubed convectors as dressing room heaters was considered to have been low. The cost of installing these heaters was reported to have been average. Thirty-three per cent of the architects reported that installation problems were complex; there were indications that these were piping problems caused by locating the units. The installation of the boiler was indicated to have been the basis of problems in installing the systems.

School administrators' responses to questionnaires. School administrators considered the gas-fired unit heaters as excellent for heating dressing rooms, but 8.3 per cent of the users reported poor quality heating while using the units, as Table VIII indicates. They reported that the loss of operating time due to breakdown and maintenance was not a problem. Cost of maintenance and difficulties found in maintaining the units were considered to have been average. Cost of operation was rated as average by users of gas-fired unit heaters, but a small percentage stated that operating costs were high. Most of the school administrators reported that gas-fired unit heaters were simple to operate.

Fan coil heaters in dressing rooms were well accepted, as most of the school administrators reported excellent performance. Administrators reported little loss of operating time due to breakdown and indicated that little operating time was lost to maintenance. Cost of maintenance was reported to have been low by approximately one-half of the users; the remainder reported the cost of maintenance to have been average. Similarly, maintaining the equipment was

TABLE VIII

SCHOOL ADMINISTRATORS' RESPONSES TO QUESTIONS REGARDING HEATING SYSTEMS USED IN THE GYMNASIUM DRESSING ROOMS OF 134 SCHOOLS

TYPES OF SYSTEMS	DOES JOB			OUT OF USE DUE TO BREAKDOWN			COST OF MAINTENANCE			DIFFICULTY OF MAINTENANCE			OUT OF USE DUE TO MAINTENANCE			COST OF OPERATION			EASE OF OPERATION		
	Per Cent			Per Cent			Per Cent			Per Cent			Per Cent			Per Cent			Per Cent		
	poor	average	excellent	little	average	large	low	average	high	simple	average	complex	little	average	large	low	average	high	simple	average	complex
Gas-fired unit heater	8.3	25.0	66.7	77.7	22.3	0	18.1	72.8	9.1	27.3	63.6	9.1	80.0	20.0	0	18.1	72.8	9.1	63.6	36.4	0
Fan coil unit heater	0	33.3	66.7	86.3	13.7	0	52.4	47.6	0	58.3	41.7	0	90.5	9.5	0	14.3	85.7	0	42.9	57.1	0
Unit heater-ventilator (hot water)	4.6	22.7	72.7	90.9	9.1	0	47.5	47.5	5.0	52.4	47.6	0	95.2	4.8	0	20.0	75.0	5.0	76.2	23.8	0
Unit heater-ventilator (steam)	5.0	20.0	75.0	95.0	0	5.0	20.0	75.0	5.0	0	75.0	5.0	75.0	20.0	5.0	25.0	75.0	0	20.0	80.0	0
Electric-fired unit heater	0	39.6	60.4	90.9	9.1	0	0	100	0	20.0	60.0	20.0	86.4	13.6	0	33.3	66.7		100	0	0
Finned-tube convector	0	33.3	66.7	33.3	66.7	0	33.3	66.7	0	66.7	33.3	0	66.7	33.3	0	16.7	66.6	16.7	33.3	66.7	0

considered to have been simple by approximately 50 per cent of the administrators. Cost of operating was considered to have been average, while opinions were closely divided between simple and average when school administrators reported the degree of ease of operating the system.

School administrators considered the hot water and steam unit heater-ventilator as excellent equipment with which to heat dressing rooms, although some reported poor performances by both types of units. Hot water unit heater-ventilators were out of use for short periods of time, as was the case in the use of steam units. A small percentage of the administrators reported a large amount of time lost because of breakdown and maintenance of steam unit heater-ventilators. Opinion was equally divided between low and average cost of maintaining the hot water units, but 5 per cent considered the cost of maintenance to have been high. Cost of maintaining steam units was reported as average. Hot water units were reported as simple or average in degree of difficulty to maintain. Both types of units were reported as having had average operating cost, although 5 per cent of the users reported that hot water units were high in operational cost. Hot water units were reported to have been simple to have been simple to operate, and steam unit heater-ventilators were reported as having had average operational complexities.

Most of the school administrators reported excellent heating for dressing rooms from the electric-fired unit heaters. The losses of operating time when using the units were reported as little for both breakdown and maintenance. Maintenance was reported as average in degree of difficulty, but 20 per cent of the school administrators considered maintenance of the electric-fired units to have been difficult. Cost of operation of the units was considered to have been average. All of the administrators believed that the units were easy to operate.

Reporting on the finned-tubed convectors as heaters in the dressing rooms was the most consistent by both architects and school administrators of all the heating reports. School administrators considered the finned-tubed convectors as excellent heaters, and maintenance problems were not serious. Cost of operating the units was generally considered to have been average; this cost was reported as low by 16.7 per cent of the administrators and high by an equal number of respondents.

Gas-fired unit heaters. Architects listed these reasons for installing the gas fired unit heaters in dressing rooms: (1) good air circulation, (2) easy to control, (3) low operating cost, (4) efficient heating, (5) low maintenance requirements, (6) safe to operate, (7) saving in heat provided, and (8) simple to operate and install. School administrators indicated that the units, when installed in dressing rooms, were: (1) easy to control, (2) simple to operate, and (3) good for circulation of air.

Problems found in using gas-fired unit heaters in dressing rooms as expressed by architects were as follows: (1) qualified personnel needed for maintenance, (2) difficult to maintain due to locations, (3) operation too noisy, (4) poor ventilation. School people reported cold floors and loss of wall space as the disadvantages of using the units.

Fan coil unit heaters. Architects listed the following advantages of fan coil heaters in the dressing rooms: (1) good air circulation, easily controlled, (2) low operating cost, (3) efficient and safe heating, (4) no flame in area, (5) simple and adaptable to use and (6) clean, even heat. School people considered the equipment to have been efficient, safe, and clean.

Architects listed the following disadvantages of fan coil heaters to heat dressing rooms: (1) higher initial cost, (2) poor ventilation, (3) not neat in appearance, and (4) trained personnel needed to maintain. School administrators found that poor ventilation was the main problem when using fan coil heaters. Other problems experience by school people were: (1) too technical to operate, (2) uneven distribution of air, and (3) noise.

Unit heater-ventilators. Architects listed these advantages of hot water unit heater-ventilators for heating dressing rooms: (1) efficient operation, (2) low maintenance, (3) safe heating, (4) good, easily controlled air circulation, (5) clean even heat, (6) heat savings, (7) no flame in the heated area, and (8) simple and adaptable use. Educators reported hot water unit heater-ventilator to have furnished good, easily controlled circulation as well as having been efficient and safe.

Architects experienced the following difficulties when using hot water unit heater-ventilators as heaters of the dressing rooms: (1) higher initial cost, (2) not neat in appearance, (3) maintenance problems due to location, and (4) too technical to operate. When school people used the hot water units, they reported: (1) inadequate ventilation, (2) uneven distribution of air, (3) noise, and (4) cold floors.

Architects and school administrators reported the same advantages for steam unit heater-ventilators as hot water units. Architects emphasized the availability of good, easily controlled air circulation and the characteristic of adaptability to a wide range of circumstances. Similarly, disadvantages listed for hot water heaters were applied to steam heaters, but school people added and emphasized the problems of the units having been too technical and requiring too much re-cycling. Architects also emphasized the steam units characteristic of having been too technical.

Electric-fired unit heaters. Simplicity of installation and operation were the chief advantages found when using electric-fired unit heaters in dressing rooms as reported by architects and school administrators. Other advantages were: (1) clean heat, (2) adaptable to various conditions, (3) efficiency of operation, and (4) economical to operate.

The chief disadvantage of these units as dressing room heaters was related to cost; that is, high operating cost and cost of maintenance. Another disadvantage was a part of the cost of maintenance; that is, the problem of maintaining specialized persons for maintenance. Educators believed, in addition, that the presence of cold floors was a disadvantage when units were used as dressing room heaters.

Finned-tubed convectors. Architects indicated that the greatest operational advantages in using the finned-tubed convectors as heaters in dressing rooms were: (1) safe, (2) low maintenance, and (3) simple. School administrators listed no advantages in the use of the units in dressing rooms.

Disadvantages discovered by the architects in using the finned-tubed convectors in dressing rooms were poor ventilation and cold floors. School administrators found these problems in evidence when using the units: (1) the floors were cold, (2) too much re-cycling was required, (3) the ventilation was poor, and (4) there was an uneven distribution of the heat.

Heating Gymnasium Small Rooms

Seventy (52.2 per cent) of the schools of this study reported small rooms closely associated with the gymnasium. As has been indicated earlier, many of the small rooms were associated with the main classroom complex; therefore, they were not reported. Table IX, Table X, and Table XI indicate that the patterns of reporting on the use of gas-fired unit heaters, fan coil unit heaters, unit heater-ventilators, and electric-fired unit heaters in small rooms of gymnasia were similar to those described in the preceding discussion. Further discussion was not undertaken. Because there is indicated in Table IX a sharp rise in the percentage of finned-tubed convectors and radiators used in small rooms over the main gymnasium area and dressing rooms, it was determined that further discussion was warranted.

Finned-tubed convectors. The finned-tubed convector was used as a heater for gymnasium small rooms in all heating zones with the

TABLE IX

HEATING SYSTEMS USED IN THE GYMNASIUM SMALL ROOMS
ARRANGED ACCORDING TO AVERAGE ANNUAL HEATING DEGREE DAYS
AND SCHOOL POPULATION GROUPS

SCHOOL POPULATION	Below 400 (20 Schools)						400 - 1200 (24 Schools)						Above 1200 (26 Schools)					
MEAN ANNUAL HEATING DEGREE DAYS	below 1,501	1,501 3,000	3,001 5,000	5,001 7,000	7,001 9,000	above 9,000	below 1,501	1,501 3,000	3,001 5,000	5,001 7,000	7,001 9,000	above 9,000	below 1,501	1,501 3,000	3,001 5,000	5,001 7,000	7,001 9,000	above 9,000
TYPES OF SYSTEMS	Per Cent						Per Cent						Per Cent					
Gas-fired unit heaters		66.7	16.6		33.3				16.7	11.1	40.0				40.0			20.0
Fan coil unit heaters		33.3	16.6			33.3			16.7	11.1				50.0	20.0			20.0
Unit heater-ventilator (hot water)						66.7				11.1								
Unit heater-ventilator (steam)			16.6	20.0					16.7	11.1						25.0		
Electric-fired unit heater			16.6	20.0							20.0						25.0	
Finned-tube convector			16.6	40.0	66.7			100	49.9	44.5					20.0	50.0	50.0	60.0
Radiators			16.6	20.0						11.1	40.0		100	50.0	20.0	25.0	25.0	

TABLE X

ARCHITECTS' RESPONSES TO QUESTIONS
REGARDING HEATING SYSTEMS USED IN THE
GYMNASIUM SMALL ROOMS OF 70 SCHOOLS

TYPES OF UNIT	COST OF UNIT			COST OF INSTALLATION			INSTALLATION PROBLEMS		
	Per Cent			Per Cent			Per Cent		
	low	average	high	low	average	high	simple	average	complex
Gas-fired unit heater	35.7	50.0	12.5	60.0	30.0	10.0	60.0	40.0	0
Fan coil unit heater	0	100	0	0	100	0	66.7	33.3	0
Unit heater-ventilator (hot water)	.0	100	0	33.3	66.7	0	0	100	0
Unit heater-ventilator (steam)	0	100	0	0	100	0	50.0	50.0	0
Electric-fired unit heater	100	0	0	100	0	0	100	0	0
Finned-tube convector	27.8	66.7	5.5	11.8	82.4	5.8	44.4	55.6	0
Radiators	46.7	53.3	0	40.0	60.0	0	73.3	26.7	0

TABLE XI

SCHOOL ADMINISTRATORS' RESPONSES TO QUESTIONS REGARDING HEATING SYSTEMS USED IN THE GYMNASIUM SMALL ROOMS OF 70 SCHOOLS

TYPES OF SYSTEMS	DOES JOB			OUT OF USE DUE TO BREAKDOWN			COST OF MAINTENANCE			DIFFICULTY OF MAINTENANCE			OUT OF USE DUE TO MAINTENANCE			COST OF OPERATION			EASE OF OPERATION		
	Per Cent			Per Cent			Per Cent			Per Cent			Per Cent			Per Cent			Per Cent		
	poor	average	excellent	little	average	large	low	average	high	simple	average	complex	little	average	large	low	average	high	simple	average	complex
Gas-fired unit heater	0	40.0	60.0	83.3	16.7	0	50.0	50.0	0	66.7	33.3	0	50.0	50.0	0	16.7	83.3	0	40.0	60.0	0
Fan coil unit heater	50.0	25.0	25.0	50.0	25.0	25.0	50.0	50.0	0	50.0	50.0	0	50.0	25.0	25.0	50.0	50.0	0	50.0	50.0	0
Unit heater-ventilator (hot water)	0	33.3	66.7	100	0	0	0	100	0	25.0	75.0	0	100	0	0	0	160	0	25.0	75.0	0
Unit heater-ventilator (steam)	20.0	20.0	60.0	100	0	0	20.0	80.0	0	40.0	60.0	0	80.0	20.0	0	0	80.0	20.0	40.0	60.0	0
Electric-fired unit heater	0	100	0	100	0	0	50.0	50.0	0	50.0	50.0	0	100	0	0	0	100	0	50.0	0	50.0
Finned-tube convector	10.5	10.5	79.0	83.3	11.1	5.6	55.6	44.4	0	66.7	33.3	0	82.3	11.8	5.9	22.2	78.8	0	70.6	29.4	0
Radiator	0	38.5	61.5	69.2	30.8	0	46.1	38.5	15.4	84.6	38.5	15.4	84.6	7.7	7.7	86.6	6.7	6.7	66.7	33.3	0

exception of the zone requiring the least amount of heating as Table IX indicates. Small and middle-sized schools in the middle MAHDD zones reported using these heaters. Schools with a student population above 1,200 in the four MAHDD zones requiring the most heat used the units in the small rooms.

Architects considered finned-tubed convectors installed in gymnasium small rooms to have been average in equipment and installation cost, as reported in Table X. Some architects reported high equipment or installation cost. The use of central water heaters or boilers with the finned-tubed convectors accounted for the high cost. Installation problems of finned-tubed convectors were not serious.

Most school administrators reported finned-tubed convectors to have been excellent heaters for gymnasium small rooms, but approximately 10 per cent experienced poor heating when using the equipment as indicated in Table XI. Minor loss of heating time due to breakdown or maintenance was reported; however, large losses were reported by a small percentage of the school administrators. Cost of maintaining the units was considered to have been low or average. Maintaining this system was reported to have been simple. School administrators reported that the system was simple to operate.

Architects listed the following characteristics of finned-tubed convectors for use in small rooms of gymnasia: (1) individual room control, (2) even temperature control, (3) simplicity of operation, installation and control, and (4) complete window expanse covered. School administrators listed the advantages of the equipment as follows: (1) efficiency, (2) low maintenance, and (3) safety.

Disadvantages found in using finned convectors for gymnasium small room heating by the architects were as follows: (1) no fresh air and (2) requirement of qualified maintenance personnel. School administrators reported the following disadvantages when using the equipment: (1) uneven distribution of heat, (2) too much re-cycling, (3) too much noise, (4) no automatic air changes, and (5) no thermostatic control.

Radiators. Radiators were used to heat the gymnasium small rooms of small and middle-sized schools in only two MAHDD zones. Large schools in five of the six MAHDD zones used radiators. This practice follows the general pattern of the large schools employing central water heating plants.

Architects' opinions regarding the cost of radiators as heaters for gymnasium small rooms were almost evenly divided between low and average. Cost of installation was considered to have been average. Architects reported that the problems encountered when installing radiators were easily solved.

School administrators reported that heating gymnasium small rooms with radiators achieved excellent results. Loss of heating time due to breakdown or maintenance was minor when using the radiator system; however, a small per cent of the school administrators reported large amounts of heating time lost due to maintenance. The degree of cost found in maintaining the equipment was as follows: (1) low, 46.1 per cent of the users; (2) average, 38.5 per cent of the users; and (3) high, 15.3 per cent of the users. A large percentage of school administrators considered the difficulties found in maintaining the heating systems as simple. Opinions related to cost of operation indicated low or average cost, but slightly more than 15 per cent of the administrators reported high cost. The operation of the equipment was reported to have been simple.

Other Heating Systems

Warm air heating system. Warm air heating systems are characterized by heating air in a central heater and then distributing the heated air to specific areas through ducts. Two warm air systems employed to heat gymnasia were reported. The following advantages were listed: (1) automatic controls make the system simple and efficient in operation, (2) make-up air is easily and economically provided, (3) floor space is not used, (4) noise level is very low, (5) constant volume of air is supplied to prevent stratification, and (6) ventilation is provided to keep air fresh, avoiding overheating. Disadvantages experienced in using the forced warm air heating system were: (1) proper maintenance of thermostats is vital to the system and (2) additional power exhaust for large crowds in mild weather is needed.

The ASHRAE listed the advantages of forced air systems as follows:

1. The furnace may be placed in any part of the structure.
2. Distribution ducts can be made small enough to be inconspicuous and out of the way, or be completely concealed from view where desired.
3. Circulation of air is positive, and in a properly designed system, can be controlled in such a way as to give a comfortably uniform temperature distribution.
4. Humidity control is readily attained.

5. The air may be cleaned by filters or other means.
6. If properly designed or suitably adapted, the same air distribution system can be used for summer cooling as for winter heating.
7. The use of the fan permits flexibility in the location of supply and return grills as required to obtain proper distribution of air for comfort.
8. Controlled quantities of ventilation air may be drawn into the system and conditioned before it is introduced into occupied portions of the structure. Recirculated air can be treated as necessary to obtain the desired quality.[19]

Panel heating. Panel heating is characterized by the heat being supplied to the area by one of its large surfaces, that is, floor, ceiling or walls. Heating elements are embedded in, or placed next to, one of the surfaces. The heating elements may be either hot water pipes, steam pipes, electrical resistance elements, or warm air ducts. The area is heated by radiation and convection by maintaining low panel surface temperatures of 80° to 125° Fahrenheit.[20]

Panel heating has been reported effective for the following purposes: (1) to warm floors in dressing room areas, (2) to provide a continuous, even temperature without draft, (3) to prevent cold down-drafts in perimeter areas, and (4) to prevent stratification. Disadvantages of panel heating were listed as follows: (1) there is a time lag between the time heat is introduced and the warming of the area, (2) care must be taken not to overheat the panel, and (3) the system is not adaptable to intermittent heating.

Infrared radiant heaters. There are three infrared heaters adaptable to gymnasium use. The metal sheath heater has a high thermal mass and a response time of two to five minutes. Control is

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[19] ASHRAE Guide and Data Book, 1962 Application, op. cit., p. 61.

[20] Patel and Mehta, op. cit., p. 163.

accomplished by a simple percentage imput timer. Reduced voltage operation is not recommended because of the drastic reduction of radiating efficiency. A dull red glow is emitted at full operation. The quartz tube heater has a quicker response time than the metal sheath heater and an equally low luminosity. The control is a percentage input timer and pulses (on and off periods) are noticed at low percentage setting only. The quartz lamp heater operates with a high filament temperature, 4,000 degrees Fahrenheit, heats in a few seconds, and emits a substantial amount of visible light.[21]

Advantages of infrared radiant heaters included: (1) low initial cost, (2) low installation cost, (3) low maintenance requirement and cost, (4) instant response, (5) no noise, (6) clean, and (7) spot heating.[22]

High temperature water heating system. High temperature water heating systems are systems that utilize water heated to temperatures above 250° Fahrenheit and below 350° Fahrenheit. The advantage in using high temperature hot water involves its heat capacity. "For instance, consider a steam system and a water system placed side by side. When cooled by the same temperature drop, the water system can supply to twenty times more heat than the steam system at the same temperature and cooled by the same temperature difference."[23] The foregoing advantage is basic, but Lieberg has listed other advantages of a practical nature:

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[21] Infrared Radiant Comfort Heaters (Pittsburg, Pa.: Edwin L. Weigant Company, Bulletin F70100-5, December, 1965), p. 2.

[22] Ibid.

[23] Paul L. Geiringer, High Temperature Water Heating (New York: John Wiley and Sons, 1963), p. 33.

(1) The system requires no steam traps and no pipe grading. Pipe can be laid at any level. No pressure reducing valves are required;
(2) While capital first costs are no more than for steam, maintenance and operating costs are considerably less than the equivalent steam system. Savings in maintenance and operating cost, taken over many years at a large number of industrial and government plants, average between 16% and 19% a year, due to lower fuel consumption and elimination of many losses;
(3) Uniform distribution of heat is independent of fluctuations in boiler pressure. Regulation is simple and flexible;
(4) Due to the high thermal storage of the entire system, a reduction in the size of the boiler or boilers is possible;
(5) Feed water treatment cost is negligible, or eliminated;
(6) Diameter of piping is reduced, due to the greater design temperature drop employed; and
(7) There is no condensate pipeline corrosion.[24]

Geiringer listed less favorable characteristics of high temperature water heating system as follows: (1) beyond the temperature range of 400-450 degrees Fahrenheit other and better carriers are available; (2) pipe supports must be designed to take care of the larger weight of water as compared with steam; (3) compared with steam, draining and filling the system is much more complex; (4) the initial filling requires purified water; and (5) if no gas absorption is provided for, scale deposits will be found in heaters and heat exchanges within a few weeks, and gas corrosion will be observed after a period of three to five years.[25]

Special Heating Procedures

Most of the special heating procedures were directed toward providing a saving in heat. Examples of these procedures were:

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[24]Owen S. Lieberg, High Temperature Water Systems (New York: The Industrial Press, 1958), pp. 5-6.

[25]Geiringer, op. cit., p. 36.

(1) gymnasium air was retempered and recirculated through dressing rooms and exhausted from shower areas, (2) gymnasium air was exhausted into dressing room areas, (3) gymnasium air was exhausted from under bleachers, (4) air returns were placed under bleachers, and (5) finned-tubed convectors and radiators were placed on window line to prevent cold down-draft and heat loss.

IV. VENTILATION

Ventilation of the various gymnasium areas was reported to have been accomplished by four principal systems: (1) windows, (2) wall mounted exhaust fans, (3) ceiling exhaust fans, and (4) unit heater-ventilators. Various combinations of mechanical ventilation systems were reported by 60 (44.7 per cent) of the schools. Forty-two (75 per cent) of the users of unit heater-ventilators reported supplemental ceiling exhaust fans or wall mounted exhaust fans.

Windows

Only 51 (38.1 per cent) of the schools reported the use of operable windows in the main gymnasium area. Of these, 98.1 per cent indicated mechanical ventilation equipment for complementing the natural ventilation of the windows. Operable windows were reported in 44.3 per cent of the dressing rooms and in 34.3 per cent of the small rooms. Ventilation systems used specifically for dressing rooms and small rooms were not reported.

Distribution of Ventilation Systems

Ventilation by wall mounted fans was reported by 39 (29.1 per cent) of the schools. The fans were reported in percentages above thirty in warmer climates by schools in all three population groups, as Table XII indicates.

Of the schools reporting exhaust ventilation systems, 20.5 per cent also reported using forced ceiling exhaust systems. Schools with populations below 400 students reported the use of the exhaust system in four of the five MACDD zones. Middle-sized schools reported the use of forced ceiling exhaust systems in two of the warmer MACDD zones. Large schools also reported the use of the system in two MACDD zones, but these were a middle zone and the coldest zone.

Unit heater ventilators and exhaust fans were used by 56 (41.8 per cent) of the schools. The largest percentage of users was in cooler climate zones. Small schools in four of five MACDD zones reported this system of ventilation. Middle-sized schools in four of five MACDD zones reported this system, excluding the warmest zone. Large schools in all but the 2,001 - 3,000 MACDD zone reported using this system of ventilation.

<u>Architects' and School Administrators' Responses to Questionnaires</u>

Wall mounted exhaust fans were reported in Table XIII to have been low in initial cost and cost of installation. Installations were said to have been simple. The efficiency of ventilating the gymnasia with wall mounted fans was reported with divided opinion, as shown in Table XIV. Most school administrators experienced little loss of operating time because of breakdown or maintenance; however, 11.7 per cent did report large operating time losses.

Architects considered the cost of forced ceiling exhaust systems and the cost of installations as average. The opinions related to

TABLE XII

VENTILATION SYSTEMS
ARRANGED ACCORDING TO MEAN ANNUAL COOLING DEGREE DAYS
AND SCHOOL POPULATION GROUPS

SCHOOL POPULATION	Below 400 (47 Schools)					400 - 1200 (47 Schools)					Above 1200 (40 Schools)				
MEAN ANNUAL COOLING DEGREE DAYS	below 501	501 1,000	1,001 2,000	2,001 3,000	above 3,000	below 501	501 1,000	1,001 2,000	2,001 3,000	above 3,000	below 501	501 1,000	1,001 2,000	2,001 3,000	above 3,000
TYPES OF SYSTEMS	Per Cent					Per Cent					Per Cent				
Wall mounted exhaust fans			66.7	50.0		50.0	37.0	33.3	33.3			50.0		100	50.0
Ceiling exhaust fans	25.0	50.0		30.0				33.3	33.3		25.0		50.0		
Unit heater-ventilator and exhaust fans	75.0	50.0	33.3	20.0		50.0	63.0	33.3	33.3		75.0	50.0	50.0		50.0

TABLE XIII

ARCHITECTS' RESPONSES TO QUESTIONS
REGARDING VENTILATION SYSTEMS
USED IN 134 GYMNASIA

TYPES OF UNIT	COST OF UNIT			COST OF INSTALLATION			INSTALLATION PROBLEMS		
	Per Cent			Per Cent			Per Cent		
	low	average	high	low	average	high	simple	average	complex
Wall mounted exhaust fans	70.0	30.0	0	70.0	30.0	0	80.0	20.0	0
Ceiling exhaust fans	25.0	75.0	0	70.0	30.0	0	50.0	50.0	0
Unit heater-ventilators and exhaust fans	20.0	50.0	30.0	22.2	66.7	11.1	63.6	36.4	0

TABLE XIV

SCHOOL ADMINISTRATORS' RESPONSES TO QUESTIONS REGARDING VENTILATION IN 134 GYMNASIA

TYPES OF SYSTEMS	DOES JOB			OUT OF USE DUE TO BREAKDOWN			COST OF MAINTENANCE			DIFFICULTY OF MAINTENANCE			OUT OF USE DUE TO MAINTENANCE			COST OF OPERATION			EASE OF OPERATION		
	Per Cent			Per Cent			Per Cent			Per Cent			Per Cent			Per Cent			Per Cent		
	poor	average	excellent	little	average	large	low	average	high	simple	average	complex	little	average	large	low	average	high	simple	average	complex
Wall mounted exhaust fans	33.3	33.3	33.3	88.9	0	11.1	44.4	55.6	0	62.5	37.5	0	88.9	0	11.1	44.4	55.6	0	50.0	50.0	0
Ceiling exhaust fans	14.3	71.4	14.3	71.4	28.6	0	42.9	57.1	0	85.7	14.3	0	57.1	42.9	0	50.0	50.0	0	71.4	28.6	0
Unit heater-ventilator and exhaust fans	21.4	42.9	35.7	66.7	22.2	11.1	46.2	46.2	7.6	46.2	53.8	0	66.7	25.0	8.3	15.4	69.2	15.4	66.7	33.3	0

installation problems were evenly divided between simple and average.

School administrators agreed that forced ceiling exhaust systems were average in performance of the designed job although 14.3 per cent of the users believed them to have been poor in performance. Reliability of this system appeared to have been high since most of the users reported little loss of use time due to breakdown and maintenance. Cost of maintenance and cost of operation were reported to have been either low or average, with the opinions approximately equally divided. Operation of the forced ceiling exhaust system was reported as simple.

Thirty per cent of the architects reported that the cost of unit heater-ventilators and exhaust fans was high when compared with others that were generally used, and 11.1 per cent indicated high cost of installation. Most of the architects reported average installation cost. Installation problems were reported as being easy to solve.

The opinions of school administrators varied considerably when reporting the efficiency of ventilating gymnasia by unit heater-ventilators and exhaust fans. Each of the responses (excellent, average, poor) was indicated by more than 20 per cent of the administrators. Loss of operating time because of breakage was considered to have been little. Cost of maintenance was generally reported as low or average. Difficulties experienced in maintaining the equipment was considered to have been average. Little loss of operating time because of maintenance was reported. Cost of operation was generally considered to have been average, but more than 15 per cent of the administrators reported high cost of operation. Operation was generally considered to have been simple.

Wall Mounted Exhaust Fans

Wall mounted exhaust fans are usually propeller fans. Propeller fan capacities are reduced substantially when fans are required to operate against resistances; they have definite limitations if required to operate with a system of ducts. However, propeller fans are by far the lowest in cost of any of the fan types for a given exhaust capacity if the system resistance is low. They are well suited to large volume and low air velocities.[26]

Advantages found in using wall mounted exhaust fans were reported as follows: (1) they may be used separately or together as needed, (2) they were easy to maintain, (3) they provided good air circulation at a low noise level, and (4) they were easy to install. Disadvantages experienced while using wall mounted exhaust fans were: (1) they pulled hot air into the gymnasium, (2) they were noisy, and (3) the location made maintenance difficult.

Ceiling Exhaust Fans

Ceiling exhaust may be either natural exhaust or direct forced exhaust. Natural exhaust is accomplished by the flow of warm air out of windows or openings in the roof which are covered by specially designed covers that enhance the flow of air and prevent the entrance of precipitation. Less than one per cent of the schools reported the use of roof ventilators; they were not included in this study.

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[26] Hemeon, *op. cit.*, p. 367.

Direct forced ceiling exhaust is accomplished by a fan whose housing is mounted on the roof of the area to be exhausted. Several different types of fans may be used for this type of ventilation. Direct exhaust ceiling ventilation systems used in gymnasia generally were of the propeller type fan or the centrifugal type fan. The multiblade centrifugal fan has a fan wheel suggestive of a rotating squirrel cage.[27] Most reports did not indicate the type of fan.

Forced ceiling exhaust users experienced the advantages of a high rate of air change and the resulting drop in temperature. The disadvantage of a high noise level was expressed by both architects and school people when discussing the equipment.

Unit Heater-Ventilators and Exhaust Fans

Advantages of the unit heater-ventilators with exhaust fans were reported as follows: (1) they were easy to maintain, (2) the rapid rate of air change reduced temperature, (3) individual room control was possible, (4) they could be used separately or together as needed, and (5) they were easy to control. Disadvantages of using the equipment for ventilating gymnasia were indicated as follows: (1) they had a high noise level, (2) they did not lower temperature sufficiently, and (3) the initial cost was high. Reiterating, some reports indicated that unit heater-ventilators without augmenting exhaust fans provided insufficient ventilation under certain conditions.

[27] Ibid, p. 370.

Large Volume, Low Speed Fans

Large diameter, low speed fans provided quite effective ventilation for gymnasia. Important factors related to this type of ventilation are: (1) the direction of air movement should be from a clean cool area through the long dimension of the building, (2) the fans should be located to allow working with the prevailing breeze, and (3) the air should be moved across the "working level" rather than above the "working level."[28]

Other Ventilation Considerations

McGrath has defined the traditional function of ventilation as the replenishing of oxygen within an area and the providing of cooling. He points out that air leakage in the average building would supply oxygen for more people than can be put into the building. Cooling by means of ventilation procedures was justified before air conditioning. He suggested that the proper approach to obtaining better air quality is through the concept of "total" air treatment. The heating and cooling equipment available today is excellent. McGrath stated that there is no reason for any structure not to be totally air conditioned. He stated that total air conditioning is obtainable and in most cases at an actual economic saving over traditional practice.[29]

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[28] Handbook on Ventilation and Cooling for Use by Architect, Engineer, Contractor and Owner (Jacksonville, Florida: American Cool Air Corporation), p. 6.

[29] William L. McGrath, "New Concepts for Obtaining Better Air Quality", Cleaning and Purification of Air in Buildings, Publication 797 (Washington: National Academy of Science - National Research Council, 1960), pp. 28-29.

V. AIR CONDITIONING

Air conditioning systems are classified as central-station systems, unitary air conditioning systems, or a combination of the central-station and unitary systems. The central-station is field erected and the components are all grouped together in a central mechanical room. Unitary air conditioning systems are characterized by factory-assembled equipment. The units may contain their own sources of heating and cooling, or the heating and cooling mediums may be supplied from a remote mechanical room. Unitary systems are divided as follows: (1) the remote air-conditioning systems in which the factory-assembled unit performs all parts of the air conditioning functions and is ordinarily separated from the refrigeration unit or heating plant; (2) the self-contained air-conditioning unit system which incorporates the refrigeration condensing unit and the heating plant all in the same enclosure. Combination central-station and unitary systems have unit air conditioners in each room which are supplied with chilled water, hot water, or steam from a central cooling and heating plant and with high-velocity conditioned air in conduit or all-air high velocity conditioned air.[30]

Other than the unit heater-ventilator, six (4.5 per cent) of the schools reported air-conditioning systems. These systems will be discussed within their air-conditioning classification.

Unit Heater-Ventilators

Unit heater-ventilators can perform the seven air conditioning

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[30]Norman C. Harris, Modern Air Conditioning Practice (New York: McGraw-Hill Book Company, Inc., 1959), pp. 196-206.

functions: "heat, humidify, cool, dehumidify, ventilate, filter, and circulate."[31] Some air-conditioning systems either omit one or more of the functions or are not designed to perform efficiently one or more of the functions. The unit heater-ventilators of this study were not designed to cool air. This function was in terms of ventilation only. Most unit heater-ventilators were not equipped to humidify and/or dehumidify air, but they could be easily adapted for humidity control. Heating, filtering, circulating air, and ventilating its service area were normal functions of the unit heater-ventilator. For these reasons the unit heater-ventilators were included as air conditioners.

Of the architects who used unit heater-ventilators, 34.8 per cent reported them as air conditioners; 8.4 per cent of the school administrators considered unit heater-ventilators as air conditioners. Lack of sufficient data prevents further discussion of this equipment as air conditioners; however, the adaptations to a "complete" air conditioner will be discussed in the section "Unitary Systems-----Remote Air Conditioning Units."

Central-Station Systems

Central-station air conditioning systems were year-round air conditioning systems. These systems were used to air condition, heat and cool, the entire gymnasium and, in one school, to cool the offices only. Usually the central-station system is not used in systems requiring less than 25 tons of cooling capacity, circulating about 10,000 cubic feet per minute of conditioned air. The mechanical room

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[31] *Ibid*, p. 190.

usually contains: (1) coils for cooling and dehumidifying, (2) coils for heating, (3) blower and driving motor, (4) sprays for cooling and humidifying or for washing the air, (5) air-cleaning equipment, and (6) control devices.[32] The conditioned air is delivered to the individual rooms through ducts that may have individual controls, as Figure 4 indicates. Chilled water cooling coils were reported by the schools that used this system. A refrigerant may be used in the cooling coils.

Advantages of the central system are as follows: (1) the investment costs are lower when compared to the total cost of separate units, (2) the space occupied is inexpensive as compared to a room unit conditioner which must be placed in the room, and (3) there is better accessibility for maintenance.[33]

Disadvantages listed by the schools were: (1) maintenance is complex and (2) the heating system must be operated when the building is being cooled, which was also listed as an advantage because it provided initial cost savings.

Unitary Systems

Remote air conditioning units. Remote air-conditioning units for cooling only are similar to fan coil unit heater or unit heater-ventilator. If remote air-conditioning units have year-round air conditioning capabilities, they perform the functions of heating and cooling in the same unit. "Remote units which are equipped with a water type coil may be arranged to cool air in summer and heat it in

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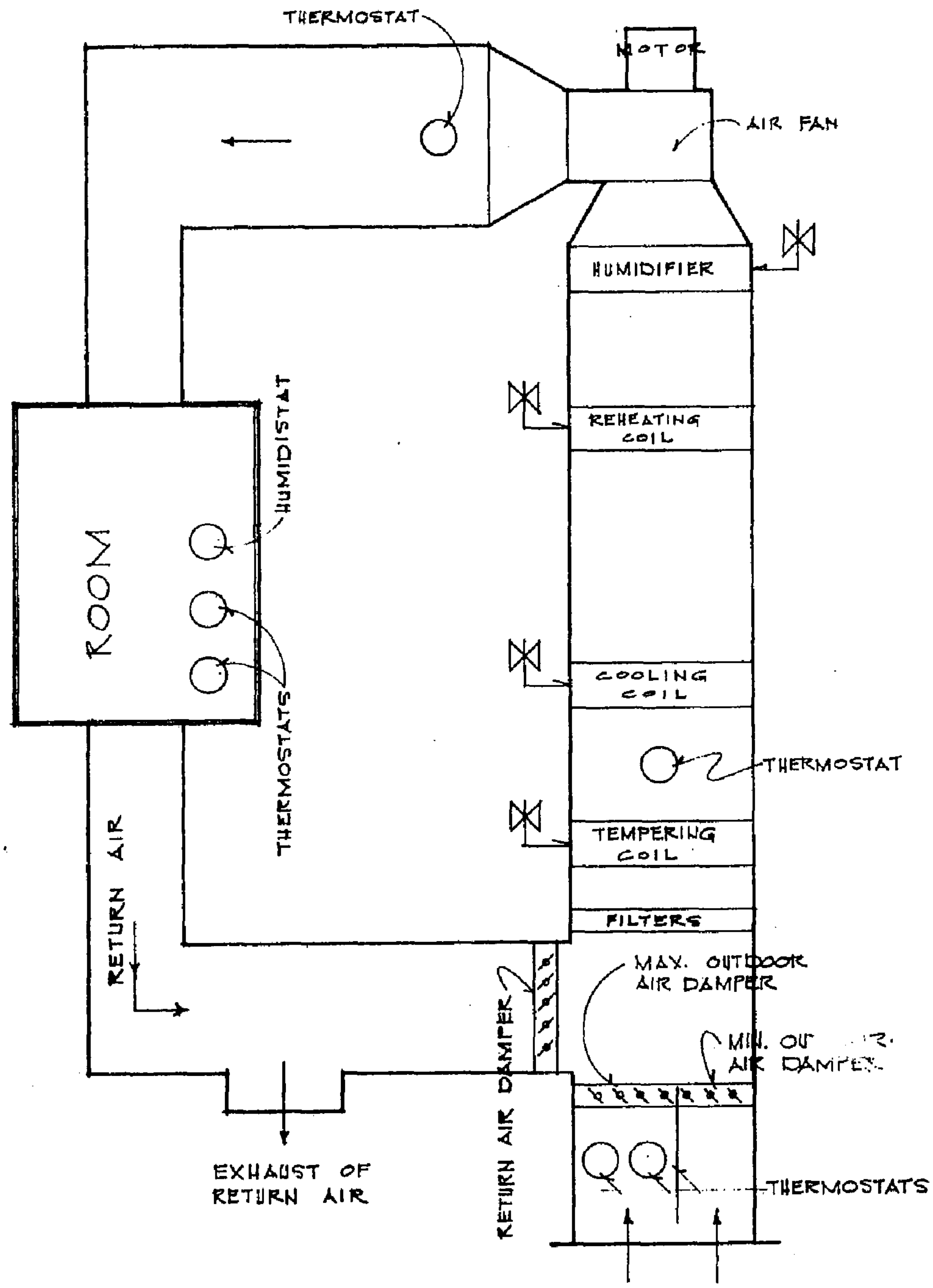
[32] Ibid, p. 191.

[33] Patel and Mehta, op. cit., p. 175.

FIGURE 4

SCHEMATIC DRAWING OF A CENTRAL AIR CONDITIONING SYSTEM*



*Patel and Mehta, op. cit., p. 174.

winter with the same coil."[34]

Two year-round remote air-conditioning units of the unit heater-ventilator type were reported. One was the individual unit type which did not have attached ducts. The other was the large unit type that delivered conditioned air through ducts. Neither of these systems provided cooled air to the dressing rooms, but they did provide ventilation.

Advantages of the remote air-conditioning units were listed as follows: (1) comparative low initial cost, (2) comparative low installation cost, and (3) easy and accurate room temperature control. If the remote unit had outside air louvers, it was possible to provide 100 per cent outside air to selected rooms while others were being heated or cooled.

Disadvantages of the remote air-conditioning units were as follows: (1) there was a slight noise level, (2) when air was delivered through ducts, the fan must run although air was needed in only one room, (3) there were several units to maintain, and (4) the location of the units caused some difficulties in maintenance.

Self-contained unit system. Two types of self-contained units were reported. The common room air conditioners for cooling only were used in offices. The electric air-to-air heat pump was used as a split system, that is, the heat pump was used as a cooler and a hot water system was used for heat. Harris explained the reason for this procedure: "The best practical heat-pump installation is one in

[34]Severns and Fellows, _op. cit._, p. 493.

which the summer cooling and the winter heating requirements both fall within the capacity limits of the machine. In very few localities in the United States is this ideal situation encountered, however."[35] The split system has been reported as a satisfactory solution to the above problem.

In maintaining a pure air-to-air heat pump system the problem has been resolved by adding supplemental heating or by using two compressors in series with each other. "The additional compressor capacity, or the supplemental heat, is generally used only in the severest winter weather and, consequently, will have a low usage factor."[36]

Harris suggested that the main disadvantage of an electric air-to-air heat pump is high operating costs in some sections of the country. He believes that the advantages of space conservation, cleanliness, safety, and trouble-free operations affect over-all operating economy and may combine to favor a heat pump installation.[37]

Combination Central-Station and Unitary Systems

Induction units. Induction units apply the principles of a central system and of a remote unit. The normal application of the system is to reduce the size of central-station duct work required in multi-room installation. Thus its use is applicable to gymnasia which are a part of the classroom complex. The primary air is

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[35]Harris, *op. cit.*, p. 277.

[36]*ASHRAE Guide and Data Book, 1962 Application*, *op. cit.*, p. 55.

[37]Harris, *op. cit.*, p. 280.

conditioned in the central-station. The water to the coil in the induction unit is heated in winter or chilled in summer at the central-station. The room air, or secondary air, passes over the coils and is mixed with the primary air within the unit housing, as Figure 5 illustrates.

Severns and Fellows listed these advantages of the system as follows: (1) if the heat losses from rooms are small, it may be possible to maintain reasonable temperature by gravity circulation, (2) better air circulation than other systems is provided, (3) the chances of cold drafts are minimized, and (4) a minimum of treated air is transported through the ducts, thus reducing power costs.[38]

All-air high velocity system. The problem of controlling the temperature in rooms of contrasting conditions can be solved by employing a central-station dual duct system, as is illustrated in Figure 6. The air is treated in the central-station, heated air is transported to a room outlet in one duct, and cooled air is transported to the same room outlet in the other duct. The air is mixed in proper proportions by mixing-valves in the room outlet. This system provides the advantages of the central-station air conditioner and provides the flexibility for cooling areas while heating others.

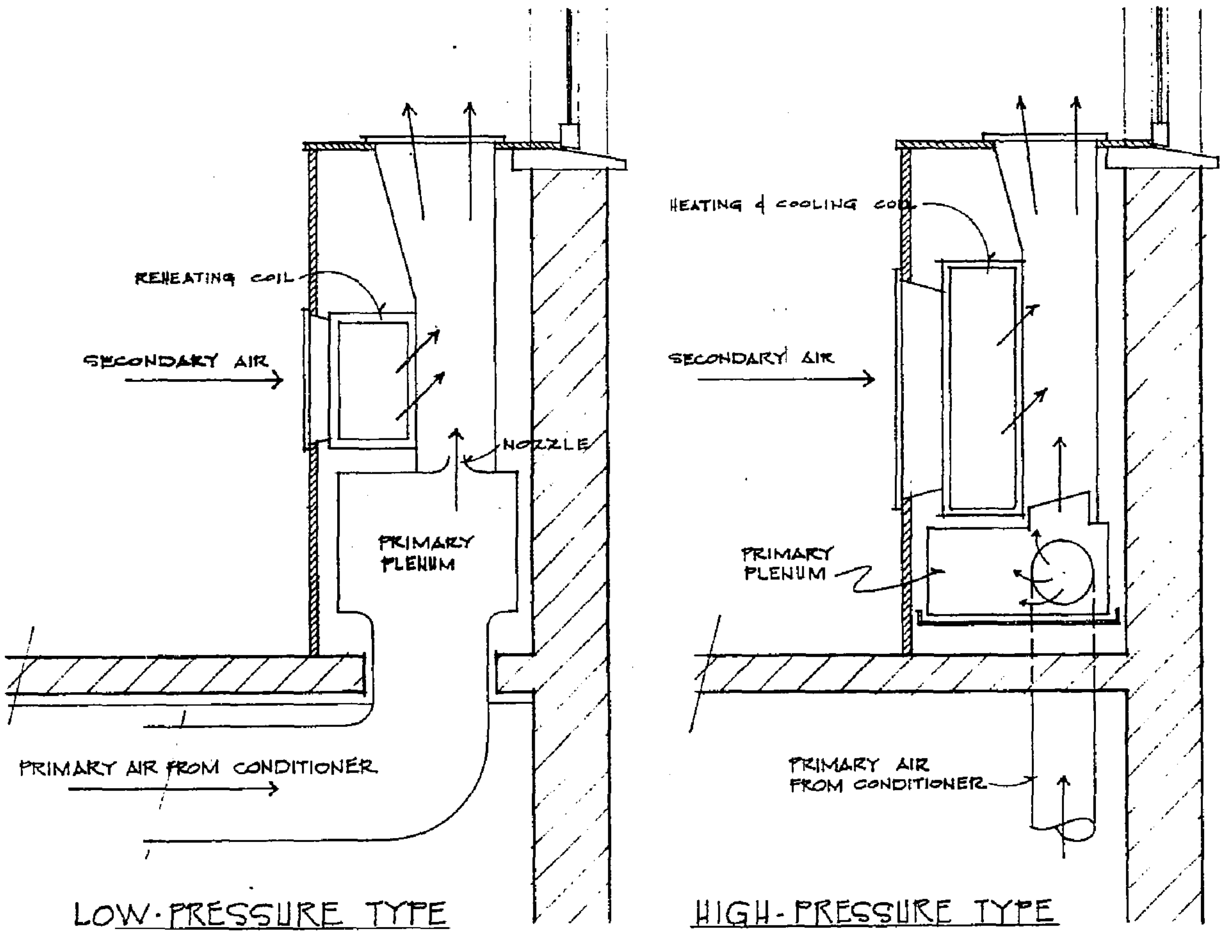
VI. SUMMARY

Heating, ventilation, and air conditioning were considered separately and according to three areas, that is, the main gymnasium area, the dressing rooms, and the small rooms. Data concerning heating were controlled by mean annual heating degree days and by

[38]Severns and Fellows, op. cit., p. 498.

FIGURE 5

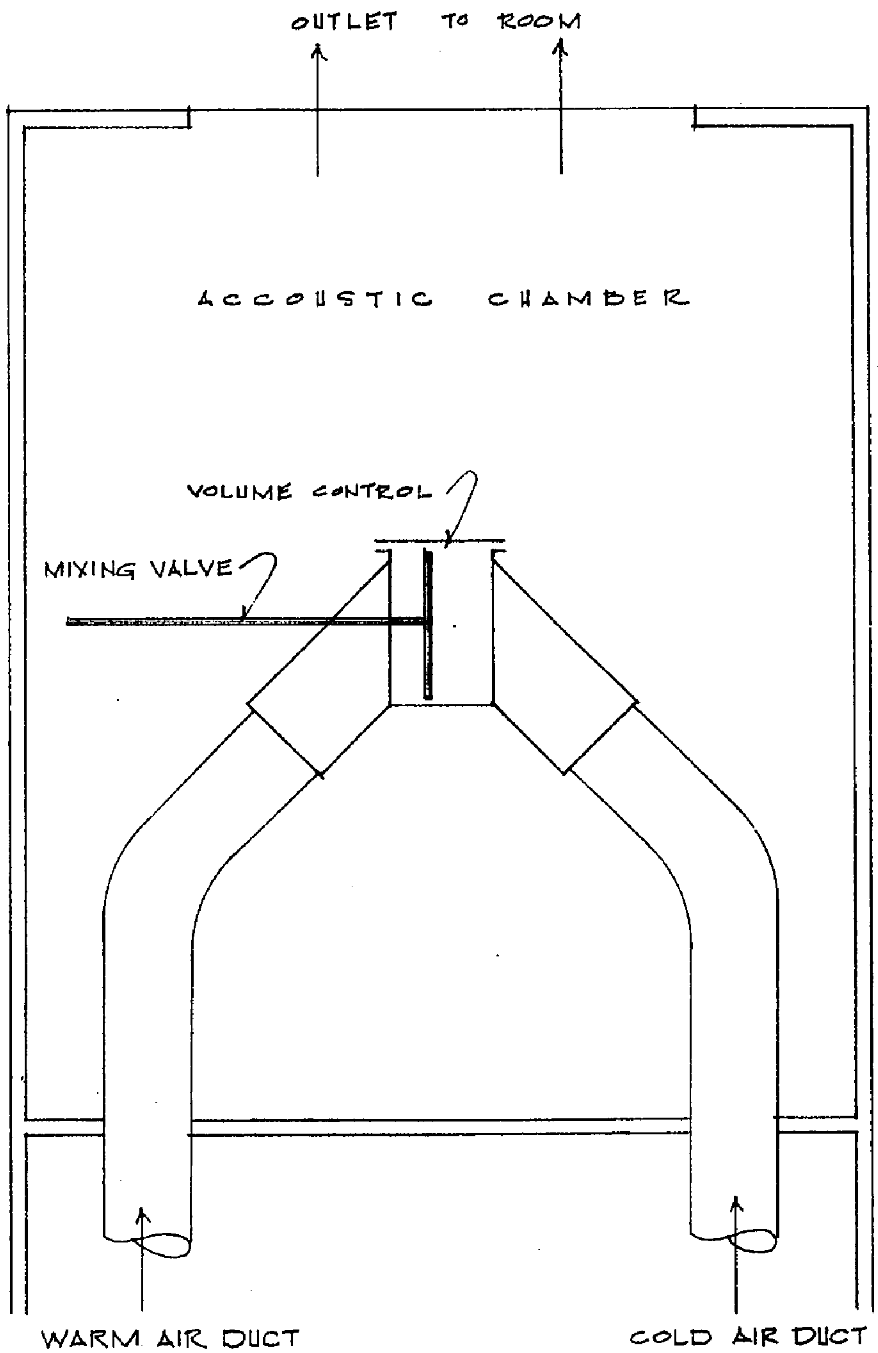
DETAIL DRAWING OF THE LOW-PRESSURE AND
HIGH-PRESSURE CENTRAL-STATION INDUCTION AIR CONDITIONING UNITS*



*Severns and Fellows, op. cit., p. 499

FIGURE 6

DETAIL DRAWING OF AN ALL-AIR HIGH
VELOCITY ROOM UNIT*



*Patel and Mehta, op. cit., p. 179

school population. Ventilation data controls were mean annual cooling degree days and school population. The discussion of air conditioning was related to the individual systems.

Heating

The heating systems were generally identified by the type of equipment used to distribute heat in a given area. The fan coil unit heater was used more often than others to heat the main gymnasium area. The finned-tube convector was the most common method used to heat small rooms. Unit heater-ventilators were used to heat more than one-third of the dressing rooms.

Natural gas flame, electrical resistance, steam, and hot water were the heating mediums. One school in Alaska used glycol as its heating medium. Hot water was used more often than any of the other media. Gas-fired unit heaters were considered to have been satisfactory low cost heaters popular in the warmer climates; they were also used in colder climates. Fan coil unit heaters were generally reported as efficient medium priced heaters. Unit heater-ventilators were generally described as efficient higher priced heaters with a high degree of versatility.

Ventilation

Windows were reported to require mechanical aid when employed as a means of ventilation. Many architects did not include operable windows in gymnasium design.

Wall mounted exhaust fans were reported to have been low priced means of ventilation. These units were considered to have been reliable, but tended to pull hot air into the gymnasia, particularly in warmer climates.

Ceiling exhaust fans were employed mainly in the middle and cooler temperature areas. They were generally reported to have been average in efficiency, but they had a high noise level.

Unit heater-ventilators were generally complemented by exhaust fans. The ability of the units to ventilate was debatable as school administrators divided their opinions almost equally among poor, average, and excellent. The units provided outside air but apparently not in sufficient quantities to satisfy the conditions in many temperature ranges.

Air Conditioning

Because the unit-heater ventilator had the ability to clean the air and to introduce and mix outside air with heated and/or indoor air, some architects considered them as air conditioners. Only a few school administrators reported the units as air conditioners because of the general association of air conditioners with refrigerated air.

Efficient year-round air conditioning was provided by remote air conditioning units. Hot water was circulated in the winter and chilled water during warmer months. Outside air was utilized as needed.

Room air conditioners were used in offices only. The only heat pump reported was used as a split system: the heat pump was used as a cooler and a hot water system was used for heat.

Experts in air conditioning generally agreed that other systems of air conditioning are efficient. Some believed that modern buildings can be built with total air conditioning and remain within the same relative cost range.

CHAPTER III

LIGHTING

Four areas of a gymnasium involve different lighting problems. The main gymnasium area requires lighting levels that accomodate both spectators and participants in physical education and athletic activities. The dressing rooms, including shower rooms, are places of high humidity where temperatures are maintained at a relatively high point with no draft ventilation. The small rooms, including offices, storerooms, and classrooms, have the conventional lighting problems. Lighting problems of the swimming pool area are similar to those of the dressing room in considering area lighting; however, the humidity level is usually higher in swimming pool areas than in the dressing rooms. There may be need for underwater lighting and accommodations for spectators. Because of these highly specialized problems and the anticipated limited number of schools reporting natatoriums, information related to swimming pool lighting was not included.

I. DEFINITION OF TERMS

1. Incandescent lighting. Light produced through heat is classified as incandescent. The common incandescent lamp has tungsten filaments and the bulbs contain inert gases, argon and nitrogen.[1]

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[1] Karl A. Staley, "Incandescent," The World Book Encyclopedia (Chicago: Field Enterprises Educational Corporation, 1961), 5, p. 130.

The amount of light given off by hot filaments is commonly indicated by bulb wattage. Individual wattage of bulbs employed in main gymnasium areas varied from 500 to 1,500. Because the design engineering of lighting is well established once the type of system has been selected, there has not been an attempt to determine the number and wattage of incandescent lamps.

2. Mercury vapor lighting. An electric discharge passing between two electrodes in a suitable gas or vapor causes the gas to emit radiation, some of which is visible as light. The lamp operating on this principle most commonly used in gymnasia is the mercury vapor lamp. When the mercury vapor lamp is cold, the mercury is mostly in liquid form and a very high voltage is required to initiate a discharge between the electrodes to vaporize the mercury. Thus a period of time is needed to "strike" the lamp. Mercury vapor lamps emit a bluish-white light.[2] High bay lighting, such as gymnasia, usually employs mercury vapor lamps of approximately 250 to 400 watts. As indicated in the discussion of incandescent lighting, there has not been an attempt to determine the number and wattage of the lamps.

3. Fluorescent lighting. Fluorescent lamps are essentially mercury vapor lamps in which the discharge takes place in mercury vapor at a very low pressure. The fundamental difference between the lamp and those previously described is the way in which light is generated. The electric discharge in mercury vapor at a low pressure gives little visible light directly, since most of the radiation is

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[2]John W. T. Walsh, Planned Artificial Lighting (London: Odhams Press Limited, 1956), p. 46.

in the ultraviolet region. The tube is coated with fluorescent materials which convert ultraviolet radiation into visible light.[3] Lamp wattage may vary from 40 to 125 watts. There has been no attempt to determine the wattage and number of fluorescent lamps used in the gymnasia.

II. LIGHTING THE MAIN GYMNASIUM AREA

Incandescent light fixtures were used to light 86 (64.2 per cent) of the main gymnasium areas. Fluorescent fixtures were used in 28 (20.9 per cent) and mercury vapor lamps were used in 18 (13.4 per cent) of the main gymnasium areas. Mixed lighting systems, mercury vapor and incandescent or mercury vapor and fluorescent, were reported by two schools.

Schools below 400 student population reported that 31 (65.9 per cent) used incandescent light for the main gymnasium areas. Fluorescent fixtures were used by 13 (27.7 per cent) schools. Mercury vapor was used by 3 (6.6 per cent) of the schools.

Schools with a population of 400 - 1,200 students reported that 27 (57.4 per cent) used incandescent lamps in the main gymnasium areas. These schools reported that 7 (14.9 per cent) used fluorescent lamps, and 11 (23.4 per cent) used mercury vapor lamps.

Twenty-eight (70 per cent) of the schools with a student population above 1,200 reported using incandescent lamps to light the main gymnasium areas. Fluorescent fixtures were used in 8 (20 per cent) of the schools. Mercury vapor lamps were used by 4 (10 per cent) large schools.

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[3] *Ibid*, p. 55.

Responses to Questions Related to Lighting the Main Gymnasium Area

Architect responses. The initial cost and the cost of installing incandescent lighting equipment in main gymnasium areas were considered to have been average by architects, Table XV indicates. Cost of the equipment was also reported as high or low by smaller percentages of architects. Reports of high or low cost of installation were also made. Installation problems were reported to have been simple.

Fluorescent lighting within the main area was found to have required average initial cost by most of the architects. Architects reported that the cost of installation of the systems was average, while they rated the problems experienced with installing the equipment as simple or average.

The initial cost of mercury vapor equipment for lighting the main gymnasium area was reported to have been average by slightly more than one-half of the architects, while slightly less than one-half rated the cost as high. Most architects said that the cost of installation was average. Problems of installation were found to have been simple or average by an equal percentage of architects.

School administrator responses. Most of the school administrators reported excellent lighting of main gymnasium areas when incandescent fixtures were used, Table XVI indicates. Most schools reported that they experienced little loss of operating time because of breakage. Cost of maintenance and cost of operation were considered to have been average. Difficulties found in maintaining the equipment were reported to have been simple or average by an equal number of the school administrators.

TABLE XV

ARCHITECTS' RESPONSES TO QUESTIONS REGARDING LIGHTING SYSTEMS IN 134 MAIN GYMNASIUM AREAS

TYPES OF SYSTEMS	COST OF UNIT			COST OF INSTALLATION			INSTALLATION PROBLEMS		
	Per Cent			Per Cent			Per Cent		
	low	average	high	low	average	high	simple	average	complex
Incandescent	20.5	69.2	10.3	21.1	73.7	5.2	64.1	30.8	5.1
Fluorescent	23.1	76.0	0	25.0	75.0	0	54.5	45.5	0
Mercury vapor	0	57.1	42.9	14.3	71.4	14.3	42.9	42.9	14.2

TABLE XVI

SCHOOL ADMINISTRATORS' RESPONSES TO
QUESTIONS REGARDING LIGHTING SYSTEMS
IN 134 MAIN GYMNASIUM AREAS

TYPES OF SYSTEMS	DOES JOB Per Cent			OUT OF USE DUE TO BREAKAGE Per Cent			COST OF MAINTENANCE Per Cent			DIFFICULTY OF MAINTENANCE Per Cent			COST OF OPERATIONS Per Cent		
	poor	average	excellent	little	average	large	low	average	high	simple	average	complex	low	average	high
Incandescent	2.1	27.1	70.8	82.6	17.4	0	36.9	60.9	2.2	55.3	44.7	0	28.9	64.4	6.7
Fluorescent	7.1	42.9	50.0	85.7	14.3	0	30.8	69.2	0	53.8	23.1	23.1	15.3	84.6	0
Mercury vapor	0	22.2	77.8	88.9	11.1	0	22.2	66.7	11.1	55.6	33.3	11.1	11.1	77.8	11.1

Fifty per cent of school administrators reported excellent lighting in main gymnasium areas when fluorescent lamps were used. Reliability of the fluorescent system was reported to have been high, with most school administrators indicating only small amounts of operating time lost because of breakage. Cost of maintenance and cost of operation were reported to have been average. Approximately one-half of the administrators considered the problems experienced during maintenance as simple.

School administrators reported that mercury vapor systems provided excellent illumination for main gymnasium areas. They reported a high reliability with little breakdown of the systems. Cost of maintaining mercury vapor systems was reported to have been average. Difficulties experienced in maintaining the equipment were said to have been simple by slightly more than one-half of the administrators. Administrators found the cost of operating the mercury vapor system as average.

Incandescent Lighting

Almost fifty per cent of the architects reported that incandescent lamps provided sufficient illumination at low cost when used to light main gymnasium areas. Other advantages of the systems of lighting were reported as follows: (1) easy to control by established procedures, (2) easy to relamp, (3) easy to spread light uniformly, and (4) easy to shield from spectators. Disadvantages when using incandescent lamps in main gymnasium areas as expressed by architects and school administrators were as follows: (1) they radiate too much heat, (2) it is difficult to replace lamps, (3) they require high operating cost, and (4) they are unattractive.

The procedure of installing lamps of larger wattage, or a larger number of lamps, over the court area than over spectator areas was reported by 9.2 per cent of the architects who used incandescent lamps. These installations provided glare-free spectator comfort as well as satisfactory light levels for athletic contests.

Fluorescent Lighting

Architects and school administrators expressed the advantages of using fluorescent lamps to light main gymnasium areas as follows: (1) illumination is sufficient and the cost is low, (2) lamp life is long, (3) illumination is spaced uniformly, and (4) arrangement of fixtures gives decorative effect. Disadvantages of these systems of illumination were listed as follows: (1) lamps are difficult to replace and (2) they have high operating cost.

The desirability of the cool operating temperatures was expressed by two architects when discussing gymnasium cooling. The adaptability of fluorescent fixtures for installations in gymnasium acoustical ceiling was stressed by one architect.

Mercury Vapor Lighting

Mercury vapor lighting in the main gymnasium area was reported to have had the following advantages: (1) uniformly spread light, (2) low cost, and (3) long lamp life. Disadvantages in using the mercury vapor system were: (1) lamps are difficult to replace, (2) bluish color is present, (3) relamping is expensive, and (4) lamps are slow in lighting.

Falk reported to an Illuminating Engineering Society Conference that there was a consistently lower first cost and substantially lower owning and operating cost for mercury systems when compared with mercury fluorescent 40 watt, rapid start systems, or the 1,500 milli-ampere fluorescent lamp systems.[4]

Mixed Lamp Systems of Lighting

One architect reported lighting the main gymnasium area by using 435-watt mercury vapor lamps and 1,000-watt incandescent lights at approximately a four to one ratio. The system was said to have given excellent results and maintained a light level of 60 footcandles on the main basketball area.

Another architect reported the system of placing mercury vapor lamps over the main court area and incorporating an auxiliary system of fluorescent lamps over the side areas. The system gave excellent main gymnasium lighting.

The publication Illuminating Engineering described the following systems used to light main gymnasium areas successfully:

> One hundred industrial type fluorescent luminaries (cold white) with 20 per cent uplight illumination were placed over the playing area in five rows on 14-foot centers. Sixty recessed incandescent units were placed over the seating area. A light level of 100 footcandles was maintained over the playing area.[5]
>
> Continuous rows of fluorescent luminaries (cold white) except for one 13-inch square special incandescent luminary every 17 feet, were spaced 16 feet apart, 22 feet above the floor. The

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[4]Norman Falk, "Mercury Lighting for General-use Industrial Areas," Illuminating Engineering, 57: 615-616, September, 1962.

[5]I.E.S. Lighting Data Sheet-Series XXVIII, "Lighting a Gymnasium," Illuminating Engineering, 58: 521-522, July, 1963.

fluorescent units used 30-by-30 degree louvers and the incandescents were 500-watt spot lamps.[6]

In a rectangular gymnasium with a pyramidal roof structure fluorescent luminaries (warm white) were placed along the X and Y axis beams and along the perimeter cove. Incandescent 150-watt down-lights were placed at each corner of the gymnasium. These lights were in groups of eight, four on each leg of the corner.[7]

The lighting objectives were stated as follows: (1) an appropriate level of lighting for intercollegiate basketball, without objectionable glare; (2) economical operating and maintenance cost; and (3) blending of the lighting system into the overall architectural concept. To meet these objectives four 400-watt, 16000-hour mercury vapor lamps were placed in custom-built three-foot diameter fixtures.

Further lighting objectives were: (1) an auxiliary system to operate during mercury striking time after a power failure, (2) low-level mood light for dances, and (3) night time illumination when the gymnasium is not in use. To meet this objective a 12-inch 80-watt panel fluorescent luminary was substituted for two of the mercury vapor lamps in certain of the fixtures.[8]

III. LIGHTING THE DRESSING ROOMS

Two systems of lighting were used for dressing rooms. Incandescent fixtures were reported to have been used in 93 (69.4 per cent) of the dressing rooms. Fluorescent fixtures were reported to have been used in 41 (30.6 per cent) of the gymnasia for dressing room lighting.

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[6] I.E.S. Lighting Data Sheet-Series XXVIII, "Lighting a Windowless Gymnasium," Illuminating Engineering, 58: 607-608, September, 1963.

[7] I.E.S. Lighting Data Sheet-Series XXVIII, "Lighting a Gymnasium," Illuminating Engineering, 58: 695-696, November, 1963.

[8] "Mercury Plus Panel Fluorescent Lights College Field House," Illuminating Engineering, 60: 304-305, April, 1965.

Responses to Questions Related to Lighting Dressing Rooms

Architect responses. The initial cost of incandescent equipment for lighting dressing rooms was considered to have been low or average, as reported in Table XVII. Cost of installing this equipment was generally considered to have been low or average also. Installation problems encountered while installing the incandescent equipment were considered to have been simple.

Cost of fluorescent equipment for lighting dressing rooms was considered by the architects to have been average. Installation cost was reported to have been average, but more than 25 per cent of the architects did report this cost to be low. Architects considered problems of installation to have been simple or average in difficulty.

School administrator responses. The quality of lighting by incandescent lamps was reported to have been excellent by the school administrators who used the equipment, as is shown in Table XVIII. The reliability of the equipment was reported to have been high, and only a small per cent of school administrators reported a large amount of operating time lost because of breakage. Cost of maintenance of the equipment was considered to have been low or average. Reports concerning difficulties experienced in maintaining equipment indicated that they were simple. Average operating cost was reported by the school administrators.

School administrators who used fluorescent lighting equipment in dressing rooms experienced excellent results in two-thirds of the cases; however, approximately one-third reported average quality lighting. The administrators reported little loss of operating time

TABLE XVII

ARCHITECTS' RESPONSES TO QUESTIONS REGARDING LIGHTING SYSTEMS IN DRESSING ROOMS OF 134 GYMNASIA

TYPES OF SYSTEMS	COST OF UNIT Per Cent			COST OF INSTALLATION Per Cent			INSTALLATION PROBLEMS Per Cent		
	low	average	high	low	average	high	simple	average	complex
Incandescent	40.5	57.1	2.4	35.7	61.9	2.4	73.8	23.8	2.4
Fluorescent	2.14	64.3	14.3	28.6	71.4	0	42.9	57.1	0

TABLE XVIII

SCHOOL ADMINISTRATORS' RESPONSES TO QUESTIONS REGARDING LIGHTING SYSTEMS IN THE DRESSING ROOMS OF 134 GYMNASIA

TYPES OF SYSTEMS	DOES JOB			OUT OF USE DUE TO BREAKAGE			COST OF MAINTENANCE			DIFFICULTY OF MAINTENANCE			COST OF OPERATIONS		
	Per Cent			Per Cent			Per Cent			Per Cent			Per Cent		
	poor	average	excellent	little	average	large	low	average	high	simple	average	complex	low	average	high
Incandescent	4.7	33.4	61.9	82.9	9.7	2.4	42.9	57.1	0	65.8	34.2	0	36.6	63.4	0
Fluorescent	5.0	35.0	60.0	89.5	10.5	0	27.8	72.2	0	62.5	37.5	0	33.3	66.7	0

because of breakage. Cost of maintenance and cost of operation were considered to have been average. Difficulties experienced when maintaining these systems were simple or average.

Incandescent Lighting

Low cost lighting and durability of incandescent systems were the most frequently listed advantages. Other advantages were that they were easy to maintain, were vapor proof, and were not subject to vandalism. Disadvantages of the incandescent systems were: (1) they had higher operating cost when compared with fluorescent lighting, (2) they were difficult to relamp, (3) they required frequent relamping, (4) they were subject to damage by students, and (5) they generated too much heat.

One architect suggested that dressing room ventilation through the light fixture was a successful augmentation to mechanical ventilation systems.

Fluorescent Lighting

Advantages of fluorescent lighting systems when used in dressing rooms were listed by architects and school administrators as follows: (1) low operating cost, (2) durable, not subject to vandalism, (3) low heat, (4) good light distribution, and (5) vapor proof. Disadvantages of the system were reported to have been that the ballasts had to be replaced occasionally and they were subject to damage by students.

IV. LIGHTING THE SMALL ROOMS

Lighting of small rooms in the gymnasium did not follow the pattern of using incandescent systems as found in other parts of the gymnasia. Incandescent systems were used for small room lighting in 25 (45.4 per cent) and fluorescent systems in 24 (43.6 per cent) of the gymnasia. Six (11 per cent) of the architects reported using a combination of fluorescent and incandescent lighting in small rooms in accordance with the system's adaptability to the particular room.

In Tables XIX and XX are evaluations which show that lighting systems in small rooms by architects and school administrators followed closely evaluations presented in the discussion of the lighting system of dressing rooms.

V. NATURAL LIGHTING

There were four systems of natural lighting reported: (1) windows, (2) sky domes, (3) glass brick, and (4) plastic panels. Less than one per cent of the schools reported the use of glass brick and plastic panels; therefore, they have not been discussed.

Schools with a population below 400 students reported that windows were used in 27 (57.4 per cent) of the main gymnasium areas, in 25 (53.2 per cent) of the gymnasia for dressing room lighting, and in 14 (43.7 per cent) of the gymnasia for small room lighting. Skylights served 5 (10.6 per cent) of the main gymnasium areas and 2 (4.2 per cent) of the gymnasia for dressing room lighting. There were no reports of sky domes serving small rooms. Natural lighting was reported not available in 12 (25.5 per cent) of the main gymnasium areas, in 19 (40.7 per cent) of the dressing rooms, and in 18 (56.3 per cent) of the small rooms.

TABLE XIX

ARCHITECTS' RESPONSES TO QUESTIONS REGARDING LIGHTING SYSTEMS IN SMALL ROOMS OF 55 GYMNASIA

TYPES OF SYSTEMS	COST OF UNIT			COST OF INSTALLATION			INSTALLATION PROBLEMS		
	Per Cent			Per Cent			Per Cent		
	low	average	high	low	average	high	simple	average	complex
Incandescent	26.3	73.7	0	21.1	78.9	0	47.4	52.6	0
Fluorescent	48.0	48.0	4.0	40.0	56.0	0	72.0	28.0	0
Fluorescent and incandescent	20.0	80.0	0	20.0	80.0	0	60.0	40.0	0

TABLE XX

SCHOOL ADMINISTRATORS' RESPONSES TO QUESTIONS
REGARDING LIGHTING SYSTEMS IN THE SMALL ROOMS
OF 55 GYMNASIA

TYPES OF SYSTEMS	DOES JOB			OUT OF USE DUE TO BREAKAGE			COST OF MAINTENANCE			DIFFICULTY OF MAINTENANCE			COST OF OPERATIONS		
	Per Cent			Per Cent			Per Cent			Per Cent			Per Cent		
	poor	average	excellent	little	average	large	low	average	high	simple	average	complex	low	average	high
Incandescent	0	37.5	62.5	83.3	16.7	0	21.7	78.3	0	60.9	33.3	0	9.1	90.9	0
Fluorescent	88.3	41.7	50.0	75.0	20.8	0	56.0	44.0	0	66.7	33.3	0	52.0	48.0	0
Fluorescent and incandescent	0	60.0	40.0	80.0	20.0	0	33.3	66.7	0	75.0	25.0	0	25.0	75.0	0

Schools with a population of 400 - 1,200 students reported that windows were used in 19 (40.4 per cent) of the main gymnasium areas, in 20 (42.6 per cent) of the gymnasia for dressing room lighting, and in 9 (33.3 per cent) of the gymnasia for small room lighting. Sky domes provided natural light for 11 (23.4 per cent) of the main gymnasium areas, for 5 (10.6 per cent) of the gymnasia for dressing room lighting, and for 2 (7.4 per cent) of the gymnasia for small room lighting.

Schools with a population above 1,200 students reported that windows were used in 13 (32.5 per cent) of the main gymnasium areas, in 20 (50 per cent) of the gymnasia for dressing room lighting, and in 12 (50 per cent) of the gymnasia for small room lighting. Sky domes provided natural light for 5 (12.5 per cent) of the main gymnasium areas, for 2 (5 per cent) of the gymnasia for dressing room lighting, and for one (4.2 per cent) of the gymnasia for small rooms. Natural light was not available in 22 (55 per cent) of the main gymnasium areas, in 8 (45 per cent) of the gymnasia in dressing rooms, and in 9 (45.8 per cent) of the gymnasia in small rooms.

Advantages found when lighting was provided by windows were as follows: (1) they served as emergency exits, (2) they provided ventilation, and (3) they provided natural light. Disadvantages found when natural light was provided by windows were as follows: (1) they had high maintenance requirements due to glass breakage, (2) they were difficult to operate, (3) they did not provide emergency exits when windows were high, and (4) they allowed glare created by sunlight.

Advantages found when natural lighting was provided by sky domes were as follows: (1) there was no breakage problem, (2) they provided good light distribution, (3) they reduced heat and glare problems, and (4) they provided an attractive interior atmosphere. Disadvantages found in sky domes were as follows: (1) they provided no emergency exits, (2) they caused full dependence on mechanical ventilation, (3) they did not provide sufficient natural light, (4) heat loss through them was greater than through walls, and (5) they did not provide an attractive outside appearance.

Schools with a population below 400 students used artificial light an average of 4.92 days each week in the main gymnasium area, 5.13 days each week in dressing rooms, and 4.88 days each week in small rooms. Natural light source was masked to some extent in the main gymnasium by 7 (14.9 per cent) schools, in dressing rooms by 4 (8.5 per cent) schools, and in small rooms by one (3.1 per cent) of the schools. The natural light source was masked completely in the main gymnasium by one (3.1 per cent), and in the small rooms by one (3.1 per cent) of the schools.

Schools with a population of 400 - 1,200 students used artificial light an average of 5.13 days each week in the main gymnasium, 5.23 days each week in dressing rooms, and 4.5 days each week in small rooms. Natural light source was masked to some extent in the main gymnasium by 9 (19.1 per cent) and in the dressing rooms by 3 (6.4 per cent) of the schools. The natural source of light was masked completely in the main gymnasium and in dressing rooms by 2 (4.3 per cent) of the schools.

Schools with a population above 1,200 students used artificial light an average of 5.26 days each week in the main gymnasium, 5.13 days each week in dressing rooms, and 5.0 days each week in the small rooms. The natural light source was masked to some extent in the main gymnasium by 6 (15 per cent) and in dressing rooms by 4 (10 per cent) of these schools. The natural light source was masked completely in the dressing rooms by 1 (2.5 per cent) of the schools.

VI. SUMMARY

Incandescent lighting in main gymnasium areas was reported more often than other types of lighting. Fluorescent lighting followed incandescent lighting in frequency of use except in schools with a population of 400 - 1,200 students. These reported mercury vapor lighting as their second choice.

Incandescent systems were reported to have been generally satisfactory. They were reported as established systems. Fluorescent gymnasium lighting systems were considered as highly reliable, low cost systems. Mercury vapor systems were reported to have been highly reliable. The systems provided long lamp-life illumination. Mercury systems were reported to have given a bluish light which two architects attempted to adjust by placing incandescent or fluorescent lamps into the system.

Incandescent lighting was the most prevalent system used for illuminating dressing rooms. The only other system used in dressing rooms was fluorescent. Reports of the architects and school administrators regarding these two systems were similar; that is, there were relatively minor differences between the two systems.

The use of incandescent and fluorescent lighting systems was almost equally divided in the report of gymnasium small rooms. Both systems were considered to have been satisfactory.

Natural lighting was provided principally by windows and sky domes. Many gymnasia had no facilities for providing natural light. Some schools that had natural light masked the windows. Artificial lighting was used during most school days.

CHAPTER IV

FLOORING

Many different flooring requirements are encountered in the planning of a gymnasium. These requirements can be classified generally by the areas which floors serve. Main gymnasium floors must "give" to prevent injury to users and yet must be firm enough to withstand the force of jumping and running. The floors must provide for bouncing a ball evenly and firmly. They must provide a non-skid surface for quick, positive stopping by a runner, and yet not be abrasive. In many instances, they must withstand the passage of large numbers of persons wearing "street" shoes.

Dressing room floors must be waterproof and yet not be slippery when wet. They must be able to withstand heavy traffic from abrasive shoes. The floors should be warm because of wet bare feet; they must be sanitary and easily cleaned. The shower room floor, which is closely associated with the dressing rooms, must be absolutely waterproof.

Special purpose rooms such as apparatus rooms, dance studios, game rooms, corrective rooms, body development rooms, and first aid rooms have individual requirements that vary slightly from the requirements listed above. For example, dance studio floors have all the requirements of a main gymnasium floor except that a studio floor should allow sliding which is required by certain dance steps.

Gymnasium classroom floors should be durable. They must be resistant to abrasive shoe soles and scraping desks. The floors should have aesthetic qualities that blend with the decor. They should meet the acoustical requirements for good classroom work.

I. DEFINITIONS OF TERMS

1. Hardwood flooring. Wood that has a high resistance to abrasive damage is called hardwood. It is generally hard, heavy, strong and durable.[1] Examples of hard woods generally used for flooring are hard maple, beech, birch, oak, walnut, pecan, and cherry.

2. Wood-composition block. Wood-composition block is compounded primarily of wood granules, Portland cement, and linseed oil. The curing process oxidizes the linseed oil to make the block highly resistant to water damage. The blocks are 6 3/16" x 2 1/6" x 3/8".[2]

3. Cork-composition flooring. Cork-composition flooring is natural cork impregnated with a wide variety of colors. It is burlap-backed and vinyl plastic coated. This material is made in rolls or tiles.[3]

4. Parquet flooring. Parquet is a flooring of inlaid design.[4]

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[1] Northern Hard Maple, Beech, Birch Flooring. Standard Specification-Official Grading Rules (Oshkosh, Wisconsin: Maple Flooring Manufacturers Association, 1965), pp. 2-5.

[2] Granwood (Greenville, South Carolina: Greenwood Flooring Co.), pp. 1-4.

[3] Gotham Color-Cork for Floors and Walls (New Rochelle, N. Y.: Gotham Materials Co., Inc.), pp. 2-4.

[4] The American Family Reference Dictionary (New York: Random House, Inc., 1964), p. 882.

The designs are made with short, quarter-sawed pieces of hardwood, either square-edge or tongue-and-grooved. They range in length from approximately 4 inches to 19 inches. Examples of designs are squares, basketweave, and herringbone.[5]

5. Troweled concrete. Troweled concrete suitable for flooring involves a critical task. High quality materials, favorable conditions and skilled workmanship are necessary to produce a serviceable floor. The following are the steps generally followed.

(1) Place the high density topping on the base concrete.
(2) Compact with tampers and screed to grade.
(3) True to a rough texture by power floating (preferred) or by hand floating.
(4) Steel troweling with a firm pressure will flatten and smooth the sandy surface left by the floating.
(5) A fine-textured surface is obtained by circular motion immediately after the first troweling.
(6) After the surface has nearly hardened, using firm pressure and troweling until the surface is hard.[6]

6. Resilience. Resilience refers to returning to the original position after being bent. Resilience of gymnasium floors places emphasis on the point that the floor bends or "gives."

To be "resilient," a flooring must have certain properties and/or perform certain functions for the user:

It should have shock-absorbing qualities.
It should "give" under impact to some degree, and absorb some of the impact energy in so doing.
It should not deform permanently or dent under the pressures or impacts of normal usage.
It should not be "dead," or softly yielding as sand, but should return some bounce to the shoe.
It should not be so springy that it acts as a trampoline.

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[5]Technical Notes (Johnson City, Tennessee: Harris Manufacturing Co., 1964), pp. 1-26.

[6]Bureau of Reclamation, Concrete Manual, Vol. 8 (seventh edition, Denver, Colorado: Department of the Interior, 1963), pp. 393-476.

It should not be absolutely rigid or hard, or should not give the impression of being so.[7]

7. Hardness. Hardness of a gymnasium floor refers to lack of resilience. Lack of proper resilience often results in leg injuries on gymnasium floors.

II. MAIN GYMNASIUM FLOORING

Main gymnasium flooring was studied from two viewpoints. First, the material from which the flooring was constructed was basic to the study of main gymnasium flooring. Second, the system by which the flooring was laid had direct bearing on the ability of main gymnasium flooring to meet requirements listed in the introduction.

Hardwood Flooring

There were three principal hardwoods used for floors in main gymnasium areas. Schools with a population below 400 students reported that 33 (70.2 per cent) schools used hard maple, 9 (19.1 per cent) used beech, and one (2.1 per cent) used pecan. Schools with a population of 400 - 1,200 students reported that 35 (74.5 per cent) schools used hard maple and 8 (17 per cent) used beech. Schools with a population above 1,200 students reported that 33 (82.5 per cent) schools used hard maple and 6 (15 per cent) used beech.

Architects' responses to questionnaires. Cost of materials for hard maple flooring in main gymnasium areas was considered to have been average, as reported in Table XXI. Both high and low material

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[7] Snell Report on Resilient Factor of Different Flooring Constructions (New York: Foster D. Snell, Inc., 1966), p. 9.

TABLE XXI

ARCHITECTS' RESPONSES TO QUESTIONS
REGARDING FLOORING SYSTEMS
IN 124 MAIN GYMNASIUM AREAS

TYPES OF FLOORING	COST OF MATERIALS			COST OF INSTALLATION			INSTALLATION PROBLEMS		
	Per Cent			Per Cent			Per Cent		
	low	average	high	low	average	high	simple	average	complex
Beech	88.9	11.8	0	54.5	45.5	9.0	70.6	29.4	0
Hard Maple	16.9	69.5	13.6	15 3	72.9	11.8	32.1	60.7	7.2

costs were reported. Average costs of installations were reported. Architects considered installation problems to have been average, and more than 30 per cent reported problems to have been simple.

The initial cost of beech was reported to have been generally low by the architects who installed these floors. Cost of installation was considered to have been low or average. Installation problems were said to have been simple.

School administrators' responses to questionnaires. According to Table XXII hard maple floors were generally considered to have been excellent by school administrators who used the floors. Average cost of maintenance was experienced, but approximately 35 per cent of the administrators reported low cost. Difficulties experienced in maintaining the floors were considered to have been average. More than one-third of the administrators reported that maintenance problems were simple. Most school administrators considered that time loss due to maintenance was not significant. Characteristics of the floors in relationship to hardness were reported as medium, although there were reports of soft and hard.

School administrators consistently evaluated beech as excellent when used for main gymnasium flooring. Cost of maintenance was reported to have been average. The time loss due to maintenance was reported as minimal. The characteristic of "hardness" was considered to have been medium by approximately one-half of the administrators, but almost one-third reported hard floors.

Hard maple. Three grades of hard maple were reported. It was not possible to determine the proportion of each grade because only

TABLE XXII

SCHOOL ADMINISTRATORS' RESPONSES
QUESTIONS REGARDING FLOORING SYSTEMS IN
124 MAIN GYMNASIUM AREAS

TYPES OF FLOORING	DOES JOB			COST OF MAINTENANCE			DIFFICULTY OF MAINTENANCE			OUT OF USE DUE TO MAINTENANCE			HARDNESS		
	Per Cent			Per Cent			Per Cent			Per Cent			Per Cent		
	poor	average	excellent	low	average	high	simple	average	complex	little	average	large	soft	medium	hard
Beech	0	17.7	82.3	29.2	50.7	13.1	22.3	64.6	13.1	88.2	11.8	0	18.4	52.4	29.2
Hard Maple	0	20.0	80.0	35.7	60.7	3.6	39.3	58.9	1.8	86.7	13.3	0	11.8	71.2	17.0

62.8 per cent of the architects who used maple reported the grade. Grade is largely determined by color matching; therefore, it did not influence the data except that concerning initial cost. First grade is more costly than second, third, or fourth grade flooring.

Small schools reported using the hard maple floor an average of 152.5 days each year for regularly scheduled classes and an average of 121.1 days each year for activities other than regularly scheduled classes. Middle-sized schools used the floors an average of 152.1 days each year for regularly scheduled classes and 123.3 days each year for activities other than regularly scheduled classes. Large schools used the floors an average of 162.2 days each year for regularly scheduled classes and 132.2 days each year for activities other than regularly scheduled classes. Traffic over the floors at times other than class time was said to have been light by 69.5 per cent, medium by 23.7 per cent, and heavy by 6.8 per cent of the school administrators who installed hard maple floors.

Beech. Small schools reported using beech floors for an average of 177.1 days each year for regularly scheduled classes and 122.3 days each year for activities other than regularly scheduled classes. Middle-sized schools used the floors for an average of 156.1 days each year for regularly scheduled classes and 125.3 days each year for activities other than regularly scheduled classes. Large schools used the floors for an average of 159.6 days each year for regularly scheduled classes. Traffic over the floors, other than class time, was reported to have been light by 70.6 per cent, medium by 23.7 per cent, and heavy by 6.8 per cent of the school administrators who installed the floors.

Other hardwood floors. Pecan floors were reported by 2 (1.5 per cent) schools. Birch and parquet were reported by two (less than 1 per cent) schools. Another flooring material that was reported by less than one per cent of the schools was end grain block. The blocks are usually pine, and are therefore not hardwood; but, because of the toughness of the end grain it is often considered as hardwood. Oak main gymnasium flooring was not reported by schools in this study.

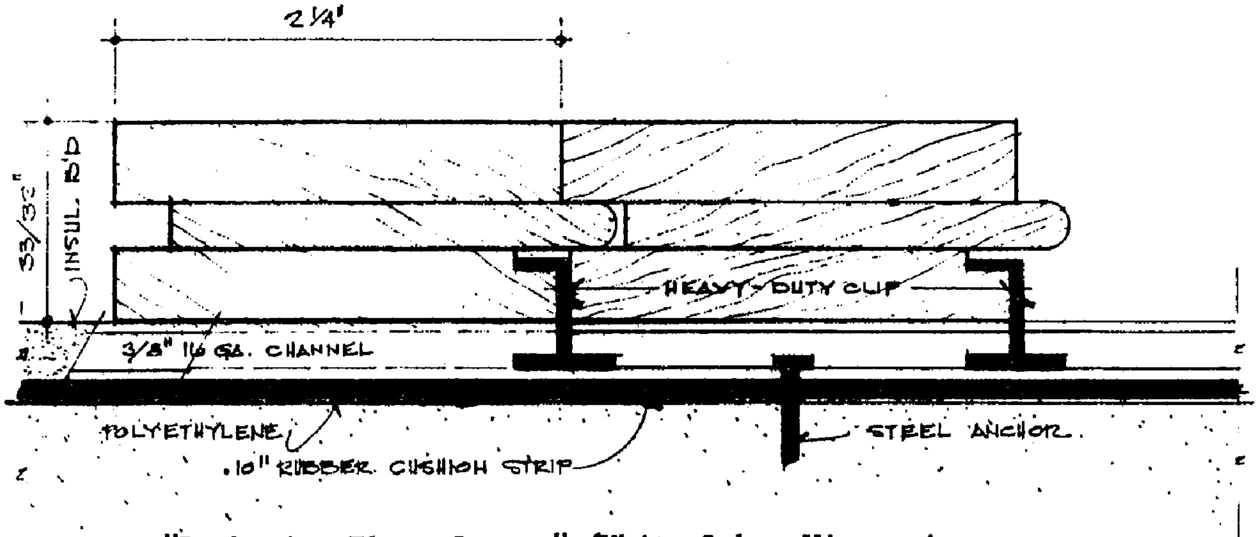
Systems for Laying Hardwood Flooring

Systems for laying hardwood floors have a definite influence on the degree of "resilience" of floors. The systems involve: (1) methods of attachment, (2) kind and design of subflooring, (3) prevention of buckling, (4) provision for "breathing" or ventilation, and (5) methods for "softening" the floor.

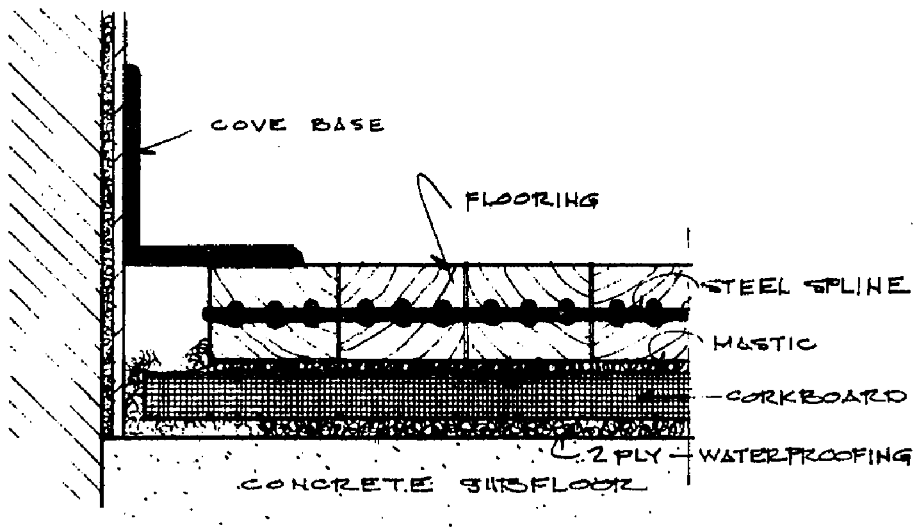
The methods of attachment of main gymnasium floors illustrated in Figure 7 are nails, mastic or adhesive, metal clips and channels, and metal splines with mastic for regularly laid even-length flooring strips. The subfloorings usually used are: (1) concrete, (2) concrete and sleeper, (3) plywood, (4) sheathing grade lumber, and (5) cork board. Prevention of buckling and provision for underfloor ventilation are usually accomplished by leaving a minimum of two inches for expansion space at the walls and no less than one inch for expansion around all columns or other projections. Ventilation is accomplished by staggering the sleepers so that the ends overlap but do not touch, or by placing the sleepers on resilient pads which allow air to pass

FIGURE 7

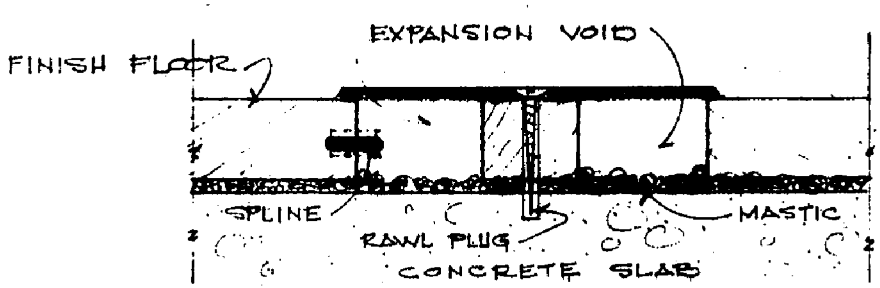
CROSS SECTIONS OF GYMNASIUM FLOORING METAL CLIP ATTACHMENTS, MASTIC AND CORK BOARD, AND METAL SPLINE



"Lock-tite Floor System" (White Lake, Wisconsin: Robbins Flooring Company, 1965), p. 1.



"Ironbound" (White Lake, Wisconsin: Robins Company, 1965), p. 2.



freely under the floor. These procedures are illustrated in Figure 8, Figure 9 , and Figure 10.

Methods usually used to "soften" the floors are as follows: (1) flooring is placed directly on the sleepers, (2) sheathing grade subfloor is randomly nailed to sleepers, (3) flooring is placed on cork board, (4) subflooring is placed on cork board, (5) sleepers are placed on resilient pads, (6) subflooring is placed on resilient pads (Figure 11), (7) subflooring is supported by a steel spring system (Figure 12) and (8) two-inch decking is placed on wide-center sleepers (Figure 13).

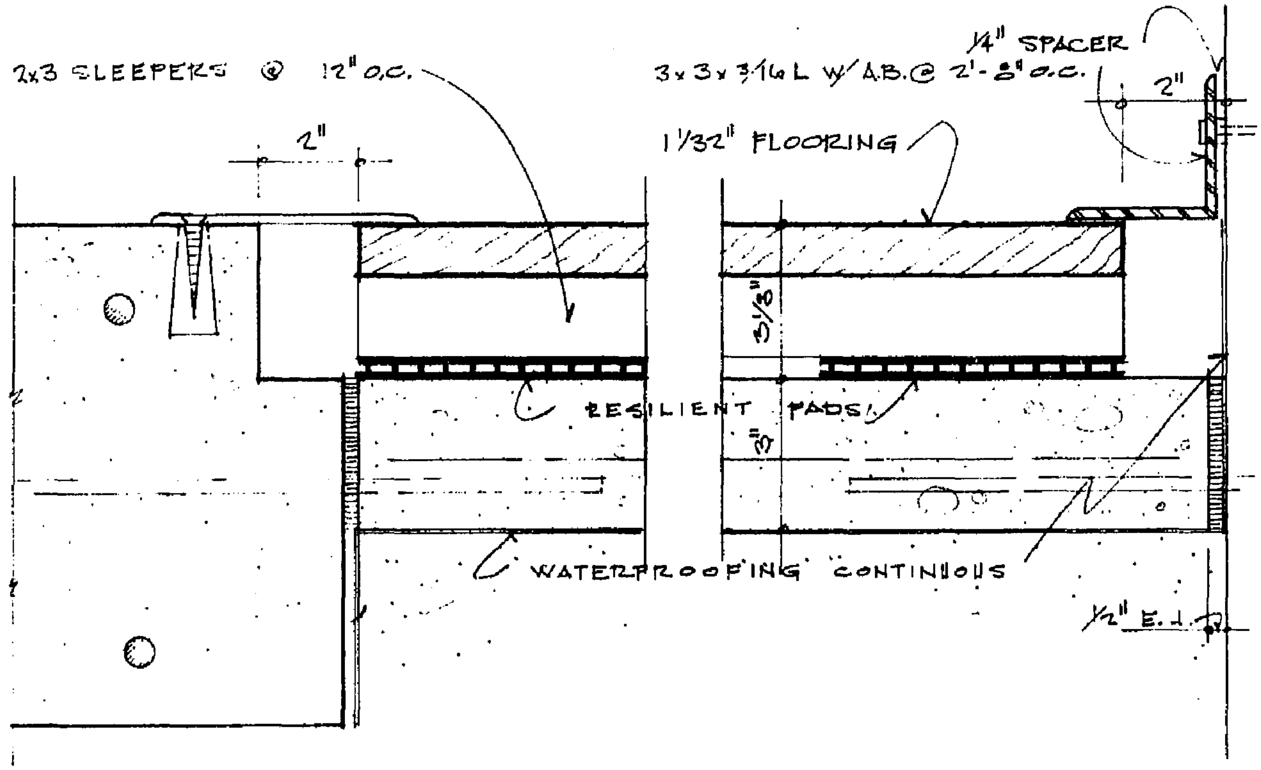
Advantages and disadvantages of hardwood flooring. Architects and school administrators listed the following advantages for hardwood flooring in the main gymnasium area: (1) beauty, (2) good resilience, (3) long life, (4) low cost, (5) easy maintenance, and (6) good ventilation. Disadvantages of hardwood flooring when used in the main gymnasium areas were listed as follows: (1) they were difficult to maintain properly when used heavily, (2) they were not fireproof, (3) expansion was a problem, and (4) they were slow to install.

Other Types of Main Gymnasium Flooring

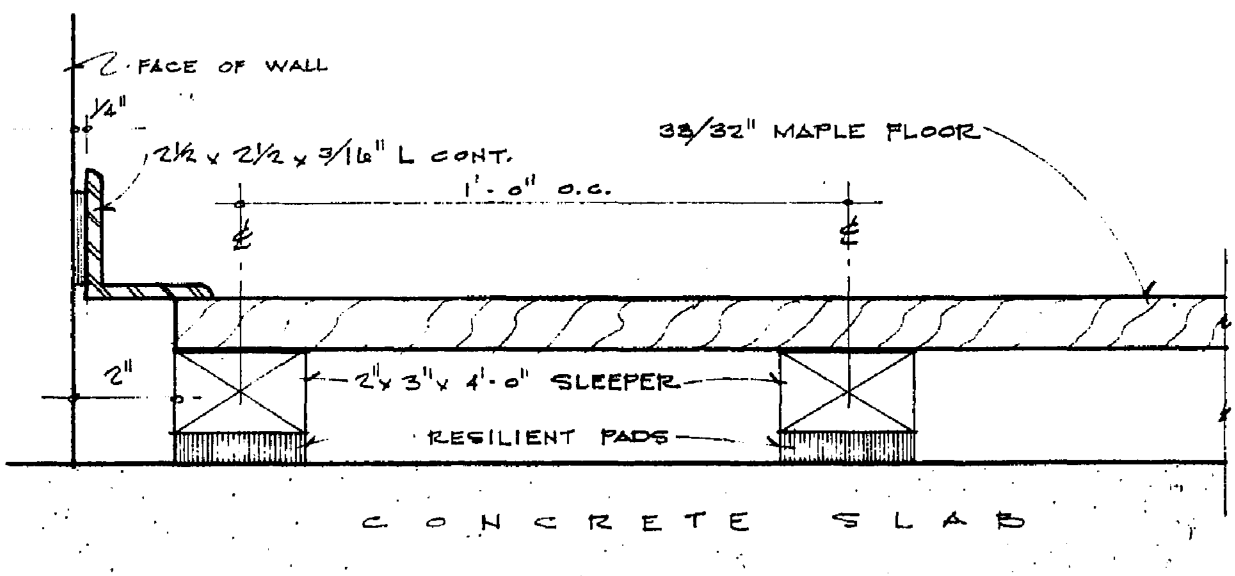
Asphalt tile. Asphalt tile as flooring for the main gymnasium area was reported by 2 (1.5 per cent) of the schools. Advantages suggested by its users were: (1) low cost, (2) permanent lines, (3) attractive, (4) no buckling, (5) easy to maintain, (6) a "live" floor, (7) no noise, and (8) no subflooring. Disadvantages found

FIGURE 8

CROSS SECTIONS OF GYMNASIUM FLOORING
SHOWING RESILIENT PADS, EXPANSION SPACES, AND
BREATHING COVE BASE



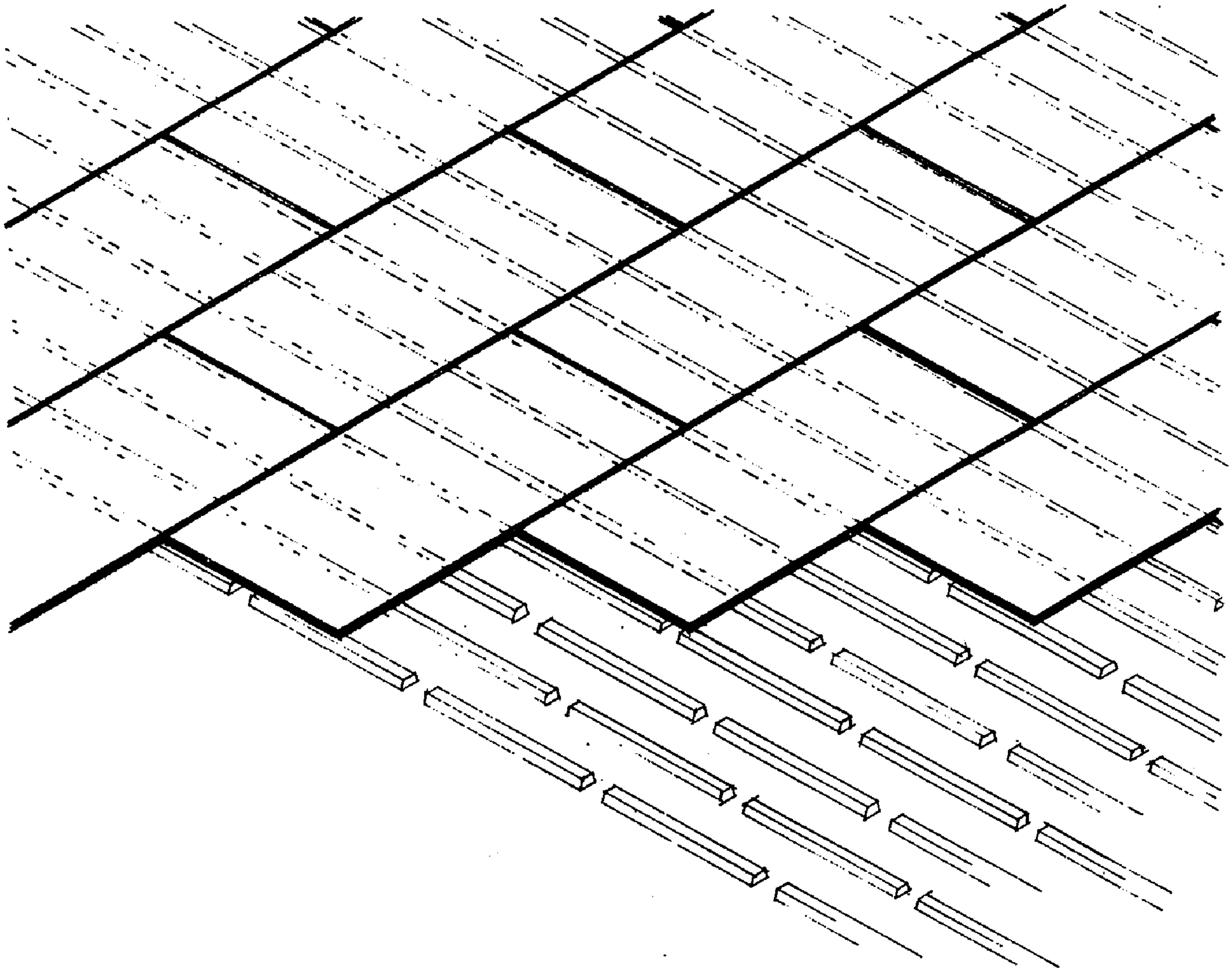
Floor Details, Woodward High School, Oklahoma.
William Appleby, Architect, Altus, Oklahoma.



Floor Detail Drawings, Blytheville High School, Arkansas. Uzzell S. Branson, Architect, Blytheville, Arkansas

FIGURE 9

ISOMETRIC AND CROSS SECTIONS
OF STAGGERED SLEEPERS



STAGGERED SLEEPERS
WITH A PLYWOOD SUBFLOOR BEING APPLIED ON TOP

Specifications, p. 19-7, Davidson High School, Mobile, Alabama. A. B. Benson and Company, Architect, Mobile, Alabama.

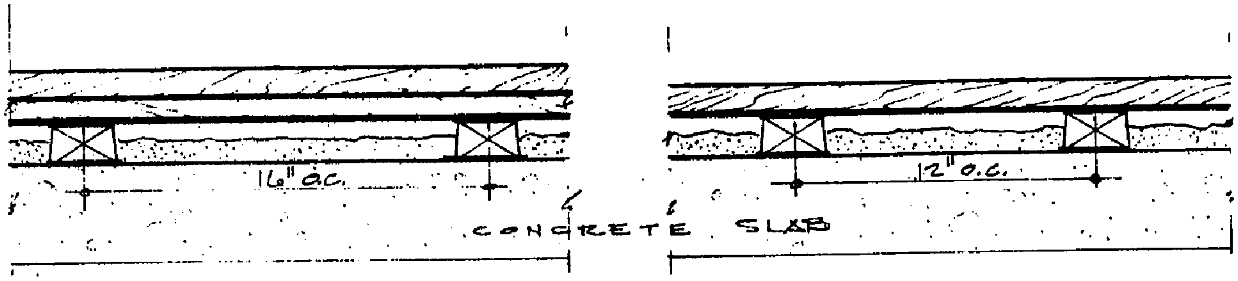
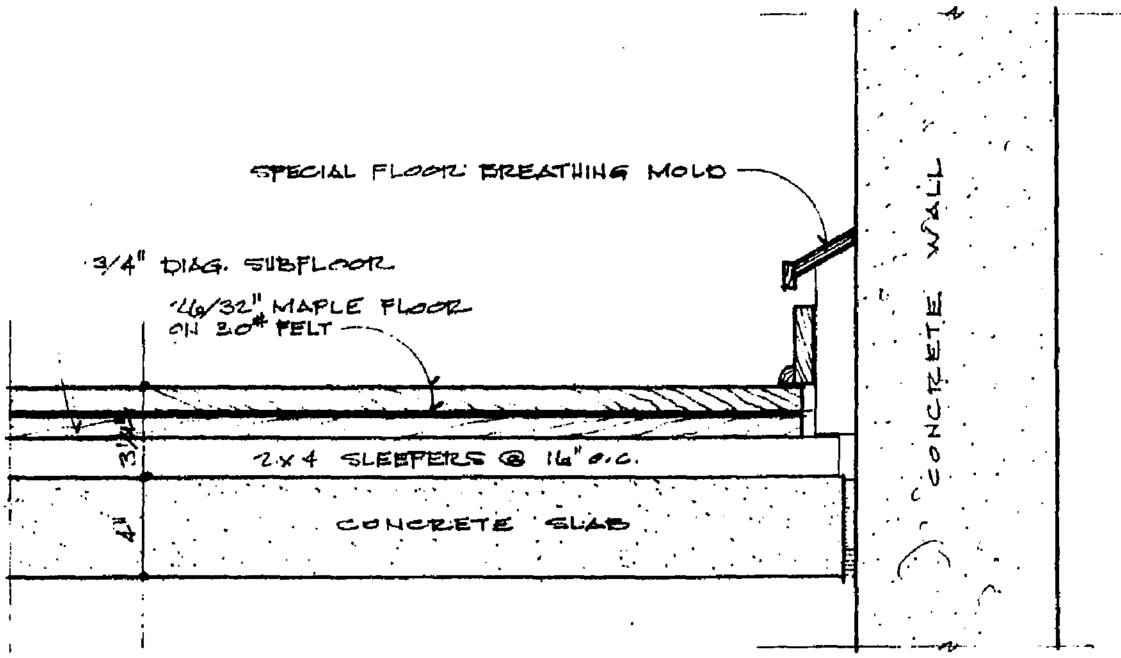
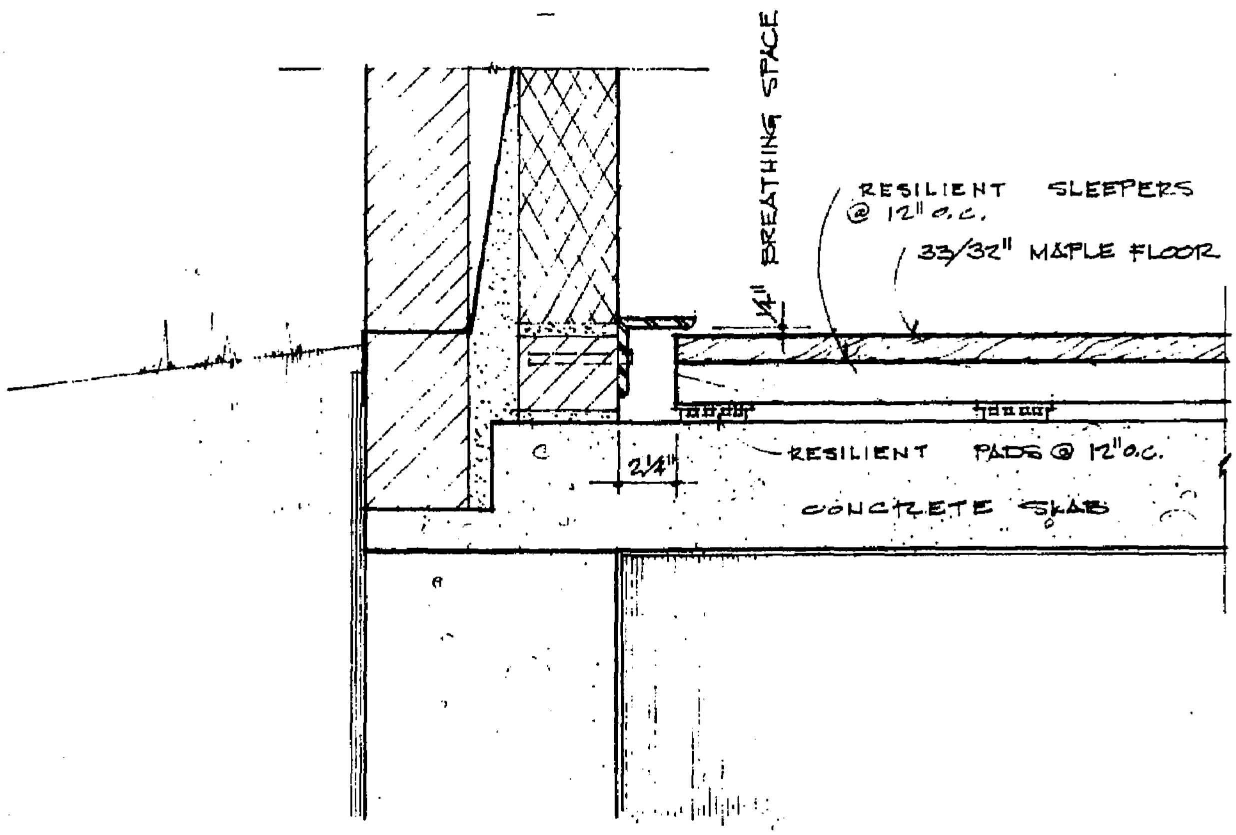


FIGURE 10

CROSS SECTIONS OF GYMNASIUM FLOORING
BREATHING MOLD ARRANGEMENTS



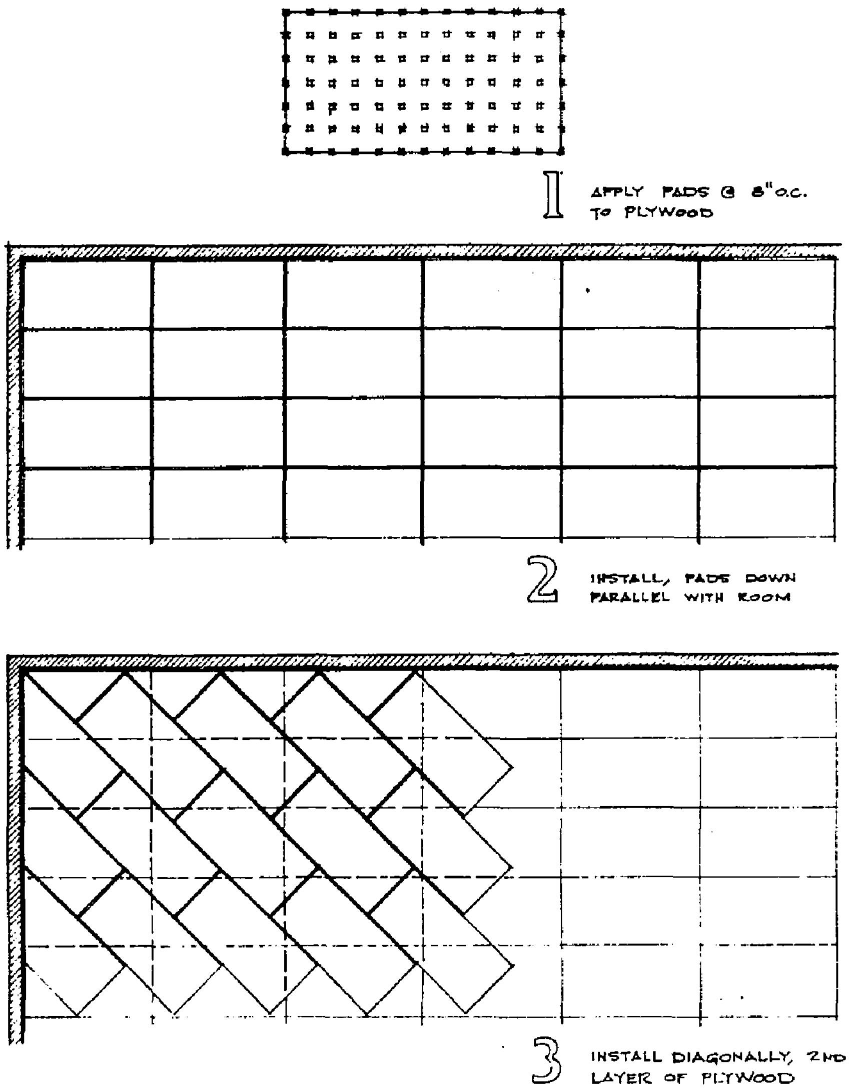
Floor Detail Drawings, Twin Falls Senior High School, Idaho. Harold E. Gerber, Architect, Twin Falls, Idaho.

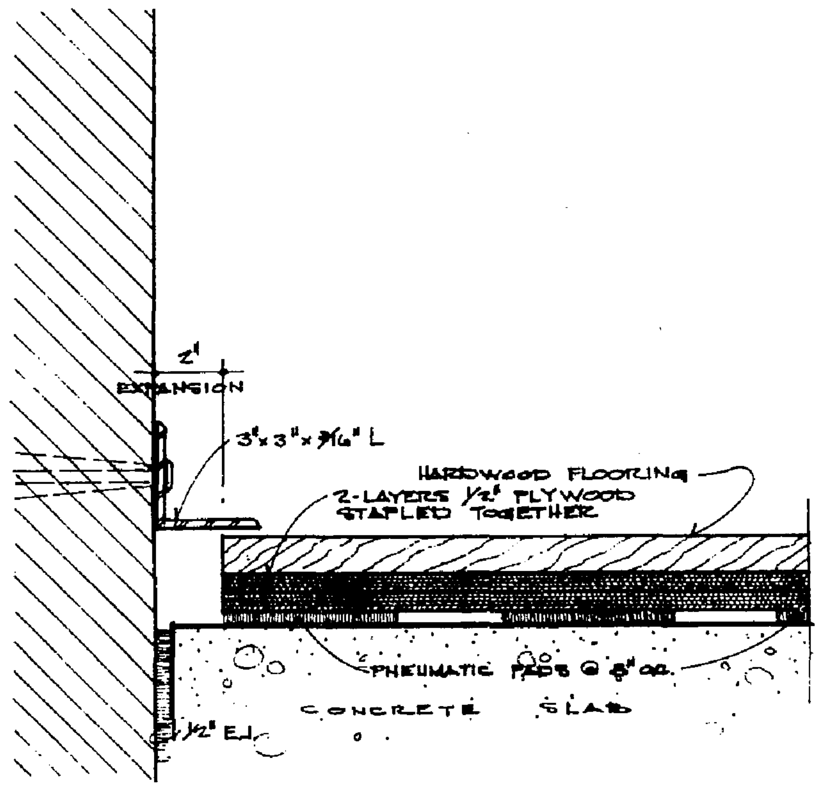


Floor Detail Drawings, El Dorado High School, Arkansas. Edwin B. Cromwell, Architect, Little Rock, Arkansas.

FIGURE 11

FLOOR PLAN VIEW AND CROSS SECTION
OF ONE SYSTEM OF GYMNASIUM FLOOR CONSTRUCTION
USING RESILIENT PADS

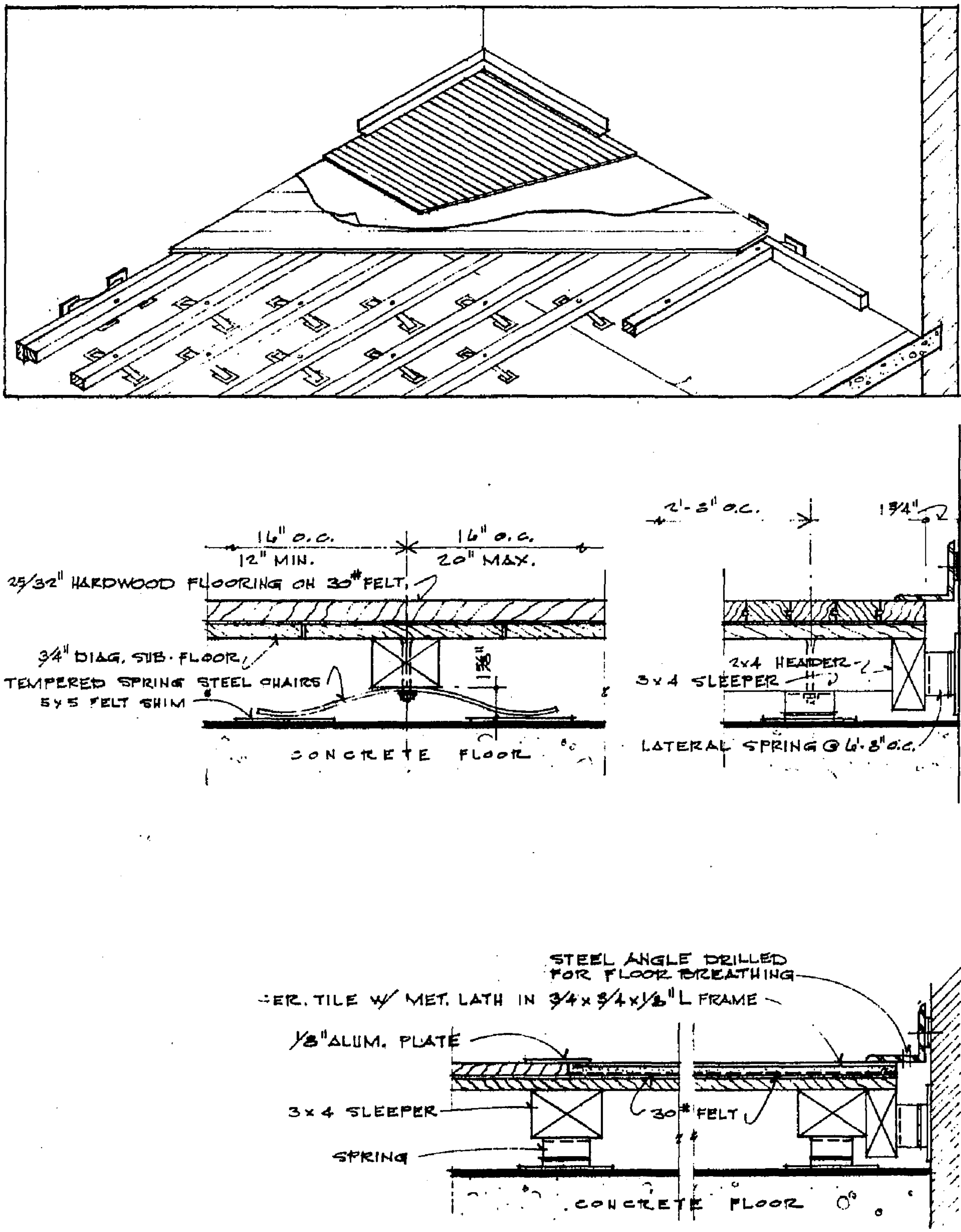




TYPICAL INSTALLATION

"Air-Thrust" (Johnson City, Tennessee: Harris
Manufacturing Co.), pp. 2-3.

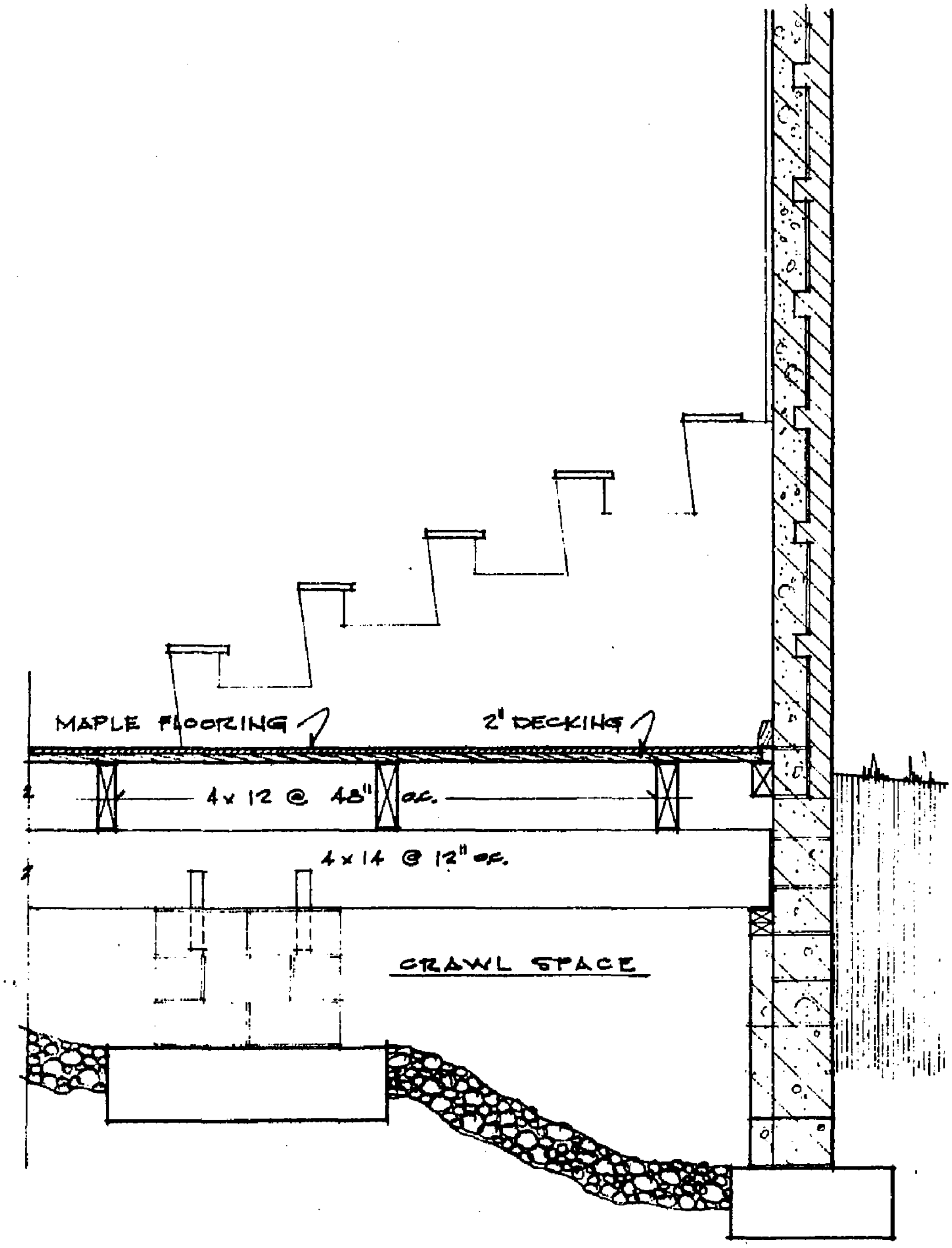
ISOMETRIC AND CROSS SECTIONS OF A GYMNASIUM
FLOORING SYSTEM USING STEEL SPRING FOR CUSHIONS



"Springaire Floor System" (Detroit, Michigan:
Springaire Floors), p. 3.

FIGURE 13

CROSS SECTIONS OF ELEVATED GYMNASIUM FLOOR USING DECKING



Section of Gymnasium Plans, Plentywood High School, Montana. Wells-Denbrook and Associates, Architects, Grand Forks, North Dakota.

when using asphalt tile for flooring in the main gymnasium were: (1) it was hard, (2) the tiles loosened, (3) it marked easily, and (4) it was slippery when wet.

Wood-composition block. The use of wood-composition block for main gymnasium flooring was reported by 2 (1.5 per cent) of the schools. The advantages listed by the users were: (1) easy to maintain, (2) permanent lines, (3) no noise, (4) safe, (5) no buckling, (6) long life, and (7) attractive. Disadvantages reported by the users were: (1) it was hard, (2) shoe soles carrying sand scratched it, and (3) the dark colors showed footprints.

III. DRESSING ROOM FLOORING

Five types of dressing room flooring were reported: concrete, quarry tile, ceramic tile, terrazzo, and asphalt tile. The numbers and percentages of schools using the various types of flooring were: (1) troweled concrete, 70 (51.5 per cent); (2) quarry tile, 39 (29.9 per cent); (3) ceramic tile, 17 (12.6 per cent); (4) terrazzo, 4 (3 per cent); and (5) asphalt tile, 4 (3 per cent).

Architects' responses to questionnaires. According to Table XXIII initial cost of troweled concrete was reported to have been low by most of the architects. Architects believed the cost of installation of the floors to have been low. Installation problems were reported as simple.

Architects considered the initial cost of quarry tile floor in dressing rooms to have been average. Average costs of installation were reported by two-thirds of the architects. Reports of low and

TABLE XXIII

ARCHITECTS' RESPONSES TO QUESTIONS
REGARDING FLOORING SYSTEMS IN 126 DRESSING ROOMS

TYPES OF FLOORING	COST OF MATERIALS Per Cent			COST OF INSTALLATION Per Cent			INSTALLATION PROBLEMS Per Cent		
	low	average	high	low	average	high	simple	average	complex
Troweled concrete	16.7	75.0	8.3	16.7	66.6	16.7	21.7	52.2	26.1
Quarry tile	76.3	21.1	2.6	78.4	18.9	2.7	86.8	10.5	26.1
Ceramic tile	0	75.0	25.0	0	75.0	25.0	33.3	44.5	22.2

high cost were equally divided. Opinions related to problems of installation were varied; however, approximately 50 per cent of the architects reported average in answer to the question.

The initial cost and cost of installing ceramic tile floors in dressing rooms were reported to have been average by 75 per cent and high by 25 per cent of the architects. Reports by architects concerning installation problems were divided among the three responses, average, simple, and complex.

School administrators' responses to questionnaires. School administrators reported that troweled concrete flooring in dressing rooms was average in quality, but almost 40 per cent believed they were excellent floors, as reported in Table XXIV. Cost of maintaining the floors was considered to have been low or average. Difficulties found in maintaining concrete floors in dressing rooms were said to have been simple or average. Time lost in the use of the floors for maintenance was not considered significant by administrators. Traction, when floors were wet, was reported to have been slippery by more than 50 per cent of the administrators.

Quarry tile dressing room flooring was considered to have been excellent by most of the school administrators. Cost of maintaining the floors was reported to have been low. Difficulties experienced during maintaining quarry tile floors were said to have been simple. All of the school administrators reported that they experienced little loss in use because of maintenance. Traction on quarry tile when wet was reported to have been good although there were some statements of poor traction.

TABLE XXIV

SCHOOL ADMINISTRATORS' RESPONSES TO QUESTIONS REGARDING FLOORING SYSTEMS IN 126 DRESSING ROOMS

TYPES OF FLOORING	DOES JOB Per Cent			COST OF MAINTENANCE Per Cent			DIFFICULTY OF MAINTENANCE Per Cent			OUT OF USE DUE TO MAINTENANCE Per Cent			TRACTION Per Cent	
	poor	average	excellent	low	average	high	simple	average	complex	little	average	large	slick	good traction
Troweled concrete	9.1	52.3	38.6	42.8	54.8	2.4	40.5	57.1	2.4	88.1	11.9	0	54.5	45.5
Quarry tile	10.0	20.0	70.0	63.6	36.4	0	63.6	36.4	0	100	0	0	18.2	81.8
Ceramic tile	0	44.4	55.6	77.8	22.2	0	44.4	55.6	0	87.5	12.5	0	77.8	22.2

Job performance of ceramic tile floors was said to have been excellent or average by school administrators. Most administrators believed the cost of maintenance to have been low. Problems experienced in maintaining the floors were said to have been average or simple. Loss of use during maintenance was indicated as having been little. Traction was reported to have been slippery when wet by most of the school administrators.

Troweled Concrete Flooring

Small schools reported that 21 (44.7 per cent) used troweled concrete flooring in their dressing rooms. The floors were reported by 29 (61.7 per cent) of the middle-sized schools. Large schools reported that 20 (50 per cent) used the floors.

Advantages of troweled concrete floors in dressing rooms as listed by architects and school administrators were: (1) easy maintenance, (2) low cost, (3) sanitary conditions, and (4) long wear. Disadvantages of these floors were listed as follows: (1) slippery when wet, (2) too hard, (3) prone to surface peeling, (4) hard to keep clean, and (5) not attractive.

Quarry Tile Flooring

Schools with a population below 400 students reported that 15 (31.9 per cent) used quarry tile for dressing room flooring. This type of flooring was reported by 9 (19.2 per cent) of the middle-sized schools and by 15 (37.5 per cent) of the large schools.

Advantages of quarry tile floors in dressing rooms as listed by architects and school administrators were: (1) easy to maintain,

(2) not slippery when wet, (3) long wear, (4) sanitary, and (5) waterproof. Disadvantages of these floors were listed as follows: (1) hard to maintain, (2) slippery when wet, and (3) high cost of materials and labor.

Ceramic Tile Flooring

Ceramic tile flooring in dressing rooms was reported by 9 (19.2 per cent) of the small schools. These floors were reported by 5 (10.6 per cent) of the middle-sized schools and by 3 (7.5 per cent) of the large schools.

Advantages of ceramic tile floors in dressing rooms as listed by the architects and school administrators were: (1) easy to maintain, (2) long wearing, (3) waterproof, (4) sanitary, and (5) beautiful. Disadvantages of the floors were listed as follows: (1) slippery when wet and (2) high cost of materials and labor.

Terrazzo Flooring

Terrazzo flooring in dressing rooms was not reported by small schools. The floors were used by 3 (6.4 per cent) of the middle-sized schools. The large schools reported that one (2.5 per cent) used these floors.

Advantages of terrazzo floors as listed by the architects and school administrators were: (1) sanitary and easy to maintain, (2) beautiful, and (3) long wearing. The one disadvantage mentioned was that terrazzo floors were slippery when wet.

Asphalt Tile Flooring

Asphalt tile flooring in dressing rooms was reported by 2 (4.2

per cent) of the small schools. One (2.1 per cent) of the middle-sized schools reported this kind of flooring and one (2.5 per cent) of the large schools used the flooring in dressing rooms.

Advantages of asphalt tile floors in dressing rooms as listed by architects and school administrators were: (1) easy to maintain, (2) low cost, (3) sanitary, (4) pleasing appearance, and (5) easy to install. Disadvantages of the floors were listed as follows: (1) slippery when wet and (2) prone to loose tiles.

IV. SHOWER ROOM FLOORING

Shower room flooring included the same types of flooring that were used in dressing rooms with the exception of asphalt tile which was not used in shower rooms. Ceramic tile was used in 75 (56 per cent), troweled concrete in 26 (19.4 per cent), quarry tile in 19 (14.1 per cent), and terrazzo in 14 (10.5 per cent) of the gymnasia for shower room flooring.

Architects' responses to questionnaires. Initial cost of ceramic tile flooring in shower rooms was reported to have been average by most of the architects, as shown in Table XXV. Reports concerning the cost of installation followed the same pattern as reports on initial cost. Installation problems were found to have been simple or average.

Architects' opinions of the initial cost of concrete floors in shower rooms were equally divided between low and average. Cost of installing the floors was considered to have been low. Problems experienced during installation were said to have been simple.

TABLE XXV

ARCHITECTS' RESPONSES TO QUESTIONS
REGARDING FLOORING SYSTEMS
IN 134 SHOWER ROOMS

TYPES OF FLOORING	COST OF MATERIALS			COST OF INSTALLATION			INSTALLATION PROBLEMS		
	Per Cent			Per Cent			Per Cent		
	low	average	high	low	average	high	simple	average	complex
Ceramic tile	11.9	69.0	19.1	9.5	71.4	19.1	40.5	57.1	2.4
Troweled concrete	50.0	50.0	0	61.5	38.5	0	71.4	28.6	0
Quarry tile	0	88.9	11.1	11.1	77.8	11.1	44.4	55.6	0
Terrazzo	0	80.0	20.0	0	100	0	40.0	60.0	0

Architects considered the initial cost of quarry tile as shower room flooring to have been average, and cost of installing the floors was reported as average. Problems of installation were considered to have been average or simple.

Initial cost of terrazzo flooring in shower rooms was considered to have been average. Twenty per cent of the architects reported high initial cost. All of the architects reported the cost of installation of the terrazzo as average. Installation problems were said to have been average.

School administrators' responses to questionnaires. School administrators who used ceramic tile shower room flooring considered them to have been excellent or average as Table XXVI indicates. Cost of maintenance was reported to have been low. Difficulties found in maintaining the floors were reported to have been simple or average. Administrators reported little loss of use because of maintenance. Ceramic tile floors under the conditions of heavy water flow of shower rooms were reported to have had good traction, but approximately 30 per cent of the administrators reported slippery floors.

The quality of performance of troweled concrete flooring in shower rooms was considered to have been average, but there were some reports of excellent performance. School administrators divided equally their opinions concerning the cost of maintaining the floors as low or average. Difficulties experienced when maintaining the floors were considered to have been average. Loss of use because of maintenance was reported to have been little. Traction was considered to have been good, but slightly more than 35 per cent of the

TABLE XXVI

SCHOOL ADMINISTRATORS' RESPONSES TO QUESTIONS REGARDING FLOORING SYSTEMS IN 134 SHOWER ROOMS

TYPES OF FLOORING	DOES JOB			COST OF MAINTENANCE			DIFFICULTY OF MAINTENANCE			OUT OF USE DUE TO MAINTENANCE			TRACTION	
	Per Cent			Per Cent			Per Cent			Per Cent			Per Cent	
	poor	average	excellent	low	average	high	simple	average	complex	little	average	large	slick	good traction
Ceramic tile	0	31.6	68.4	64.9	35.1	0	56.8	43.2	0	80.6	19.4	0	31.6	68.4
Troweled concrete	14.3	57.1	38.6	50.0	50.0	0	28.6	71.4	0	85.7	14.3	0	37.5	62.4
Quarry tile	0	27.3	72.7	72.7	27.3	0	72.7	27.3	0	100	0	0	18.2	81.8
Terrazzo	0	42.9	57.1	66.7	33.3	0	85.7	14.3	0	100	0	0	57.1	42.9

school administrators reported slippery floors.

The quality of quarry tile as shower room flooring was reported as excellent. Cost of maintaining the floors was said to have been low. All of the administrators reported that there was little loss of use because of maintenance. Traction was reported to have been good by more than 80 per cent of the school administrators.

Quality of terrazzo flooring in shower rooms was reported to have been excellent or average, and cost of maintenance was reported to be low. Difficulties in maintaining terrazzo shower room floors were considered to have been simple. All of the school administrators reported little loss of use because of maintaining these floors. Traction when wet was reported to have been slippery by more than 50 per cent of the administrators.

Ceramic Tile Flooring

Twenty-nine (61.7 per cent) of the small schools reported the use of ceramic tile flooring in shower rooms. This flooring was reported by 24 (51.1 per cent) of the middle-sized schools, and by 22 (55 per cent) of the large schools.

Advantages found in using ceramic tile in shower rooms as listed by architects and school administrators were: (1) easy to maintain, (2) attractive, (3) sanitary, (4) good traction, (5) no showing of cracks, (6) low cost when related to results, and (7) waterproof. Disadvantages of the floors were listed as follows: (1) they were of high cost, (2) grout deteriorated, (3) grout spread athlete's foot, and (4) they were slippery.

Troweled Concrete Flooring

Troweled concrete flooring in shower rooms was reported by 8 (17 per cent) of the small schools. This flooring was used by 12 (25.5 per cent) of the middle-sized schools and by 6 (15 per cent) of the large schools.

Advantages of using troweled concrete flooring in shower rooms were listed by architects and school administrators as follows: (1) easy to maintain, (2) no joints, (3) sanitary, (4) low cost, and (5) long life. Disadvantages listed for the floors were: (1) appearance, (2) difficult to keep clean, (3) slippery, and (4) leaky.

Quarry Tile Flooring

Quarry tile floors in shower rooms were used in 8 (17 per cent) of the small schools. This flooring was used in 3 (6.4 per cent) of the middle-sized schools. Large schools reported that 8 (20 per cent) used quarry tile floors.

Advantages of quarry tile shower room floors as listed by architects and school administrators were: (1) easy to maintain, (2) non-slip, (3) easy to clean, and (4) long life. Disadvantages of the flooring were listed as follows: (1) it was high cost, (2) grout deteriorated, and (3) it was difficult to keep clean.

Terrazzo Flooring

Terrazzo flooring in shower rooms was used by 2 (4.3 per cent) of the small schools. Middle-sized schools reported that 8 (17 per cent) used the floors. Four (10 per cent) of the large schools used terrazzo flooring.

Advantages of terrazzo flooring in shower rooms as reported by architects and school administrators were: (1) easy to maintain, (2) no joints, (3) long life, (4) sanitary, (5) attractive, and (6) waterproof. Disadvantages listed were as follows: (1) slippery and (2) high cost.

Design of Shower Room Flooring

Most of the shower room floor designing problems have been caused by the presence of large amounts of water. Various solutions of these problems were exhibited by floor drawings taken from detail drawings and prints submitted by architects. The simple solution was a sharp grade to a floor drain, or floor drains, to accomplish fast run-off of the water. Another solution to fast run-off was the use of gutters, as is shown in Figure 14.

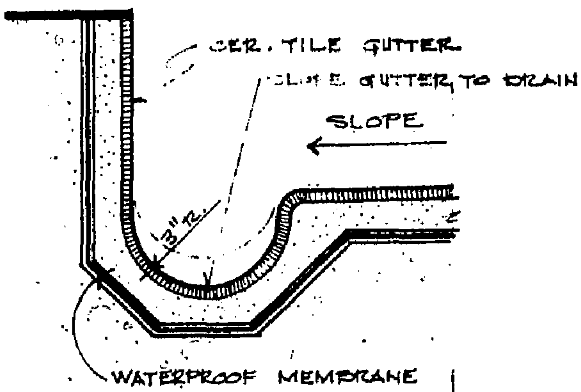
Various arrangements of waterproof membranes were illustrated in the details. A full copper pan with copper flashing around floor drains to provide added protection against seepage or weeping was illustrated. A full lead pan arrangement was also illustrated. A full lead pan shower room flooring design was reported with floor drains through the lead pan and another with a non-penetrated lead pan which used a fast run-off gutter system.

V. CLASSROOM FLOORING

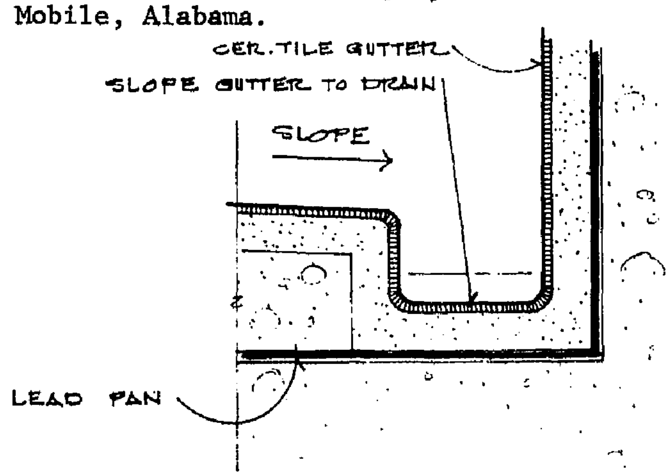
Some gymnasia do not have classrooms within the gymnasium structure. Classrooms were reported by 47.5 per cent of the schools with a population below 400 students, by 69.7 per cent of the schools with a population of 400 - 1,200 students, and 63.3 per cent of the schools with more than 1,200 students.

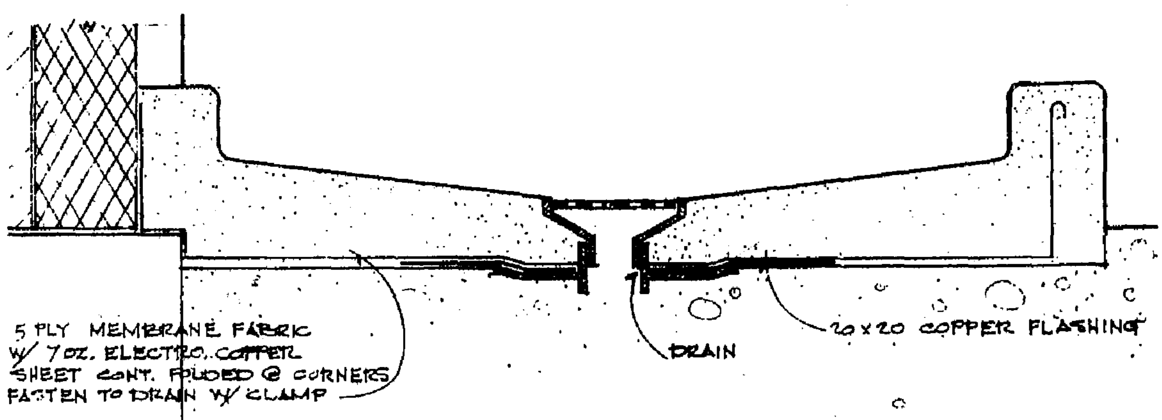
FIGURE 14

CROSS SECTIONS OF SHOWER ROOM FLOORING
SHOWING GUTTER ARRANGEMENTS, LEAD PAN, COPPER
PAN AND COPPER FLASHING WITH CENTER DRAIN



Shower Gutter Detail Drawings, Davidson High
School, Mobile, Alabama. A. B. Benson and Company
Architects, Mobile, Alabama.





Shower Floor Detail Drawings, Waterville Senior
High School, Main. Bunker and Savage, Architects,
Augusta, Maine.

Asphalt tile, vinyl tile, composition-cork tile and troweled concrete floors were reported. Because of the relatively limited number of classrooms reported, the data were considered as inconclusive; however, there were indications that schools with a population below 400 students used asphalt tile more often. Of these schools 62.5 per cent used asphalt tile. Schools in the 400 - 1,200 and above 1,200 population groups indicated that they used vinyl tile more often, percentages reporting were 52.2 and 52.6 per cent respectively.

Attractive and low cost flooring were mentioned as the advantages found in using asphalt tile in the classrooms. Disadvantages of asphalt tile were associated with problems experienced in maintaining the tile.

The advantages found in using vinyl tile in classrooms were listed as follows: (1) low cost, resilient floor covering, (2) durable, (3) easily laid, and (4) easy to maintain. It was reported that furniture caused indentures in the vinyl tile. Shoe noises were also experienced in classrooms with vinyl tile floors.

VI. APPARATUS ROOM FLOORING

Many gymnasia did not include apparatus rooms. Schools with a population below 400 students reported that 65.7 per cent of the gymnasia contained apparatus rooms. Apparatus rooms within the gymnasium were reported by 63.6 per cent of the schools with a population of 400 to 1,200 students and by 73.3 per cent of the schools with a population above 1,200 students.

Four types of flooring were reported as having been used in the apparatus rooms: troweled concrete, vinyl tile, hard maple, and quarry tile. Schools in each of the population groups indicated a trend toward using troweled concrete more frequently. The trend was not clear in the population group of 400 - 1,200 students in which 33.3 per cent of the schools reported using troweled concrete.

Advantages found in using troweled concrete floors in apparatus rooms were: (1) low cost, (2) durable, (3) easy to clean, and (4) a good base for mats. Disadvantages of the floors were listed as follows: (1) difficult to keep clean, (2) prone to show cracks, (3) no resilience, and (4) drab color.

VII. GAMES ROOM FLOORING

Schools with a population below 400 students reported that 47.5 per cent had games rooms in the gymnasia. Those schools with a population of 400 - 1,200 reported games rooms in 42.4 per cent of the gymnasia, and 40 per cent of the schools with a population above 1,200 students had games rooms.

Troweled concrete, terrazzo, asphalt tile, hard maple, and birch were identified as flooring for games rooms. There was a definite trend as in the apparatus rooms toward using troweled concrete for floors. Troweled concrete flooring was used in 38.1 per cent of the games rooms. Asphalt tile was reported as having been used in 28.6 per cent of the games rooms.

VIII. SUMMARY

Main Gymnasium Flooring

Flooring was considered according to basic area, that is, main gymnasium area, dressing rooms, and shower rooms. Data related to classroom, apparatus room, and games room flooring were also a part of this study. The data were controlled according to school size groups.

Of 134 schools, 101 used hard maple for main gymnasium flooring. The design of the system for laying hardwood flooring was important to the degree of resilience. Flooring systems involving resilience pads were used more often than others. This flooring was reported to have been excellent.

Other hardwoods used were beech, pecan, birch, parquet, and end grain block. Other types of main gymnasium flooring were asphalt tile and wood-composition block.

Dressing Room Flooring

Troweled concrete and quarry tile were listed as dressing room floors that were used more often than others. Troweled concrete was reported to have been satisfactory but prone toward poor traction when wet. Quarry tile was high cost but excellent flooring. Other types of flooring used in dressing rooms were ceramic tile, terrazzo, and asphalt tile.

Shower Room Flooring

Ceramic tile was the most popular shower room flooring. The floors had high initial cost but gave excellent service. Lower cost troweled concrete was reported less often than ceramic tile. Other shower room floors were quarry tile and terrazzo.

Shower room flooring design involved some metallic membrane and a fast run-off trough to contain water. Copper and lead were suggested as excellent metals for this purpose.

Other Flooring

Small schools used asphalt tile classroom flooring more often than other types. Middle-sized and large schools used vinyl tile classroom flooring predominantly.

Troweled concrete was the most popular flooring in apparatus rooms and games rooms. Asphalt tile was the second most popular flooring for games rooms.

CHAPTER V

DRESSING AND SHOWERING FACILITIES

A major objective of this portion of the study was to survey the active clothing storage facilities. The physical education and athletic dressing types of active clothing storage were included. Not all gymnasia provided separate areas for physical education and athletic dressing; 15 (11.2 per cent) of the schools reported using the same area. Sometimes active clothing storage facilities were considered as a part of equipment purchase; thus 5 (3.7 per cent) of the architects reported that they lacked specifications for these facilities.

The study of dressing facilities included showering facilities. It was assumed that boys' shower rooms were gang type as opposed to private type, and a visual inspection of the floor plan prints proved the accuracy of this assumption. There were four hallway type arrangements, which provide for shower heads on both walls of a narrow hallway. Boys pass down the hallway and shower as they move. The arrangement provides a saving in space and decreases showering time.

I. DEFINITIONS OF TERMS

1. Two-tier lockers. Two-tier lockers are frequently described as double-tier lockers. The term two-tier refers to the height of the locker arrangement; that is, one locker is placed on top of another. These provide twice the number of individual lockers

usually provided by the full-length, or wardrobe lockers, whose heights are generally 54 inches, 60 inches, or 72 inches.

2. _Full-length lockers with box lockers_. Box lockers are small, usually 12" x 12" x 15", or 12" x 12" x 12". Five or six of the lockers are tiered alongside a wardrobe locker of equal height. At times there may be two or even three rows of the box lockers for each full-length locker.

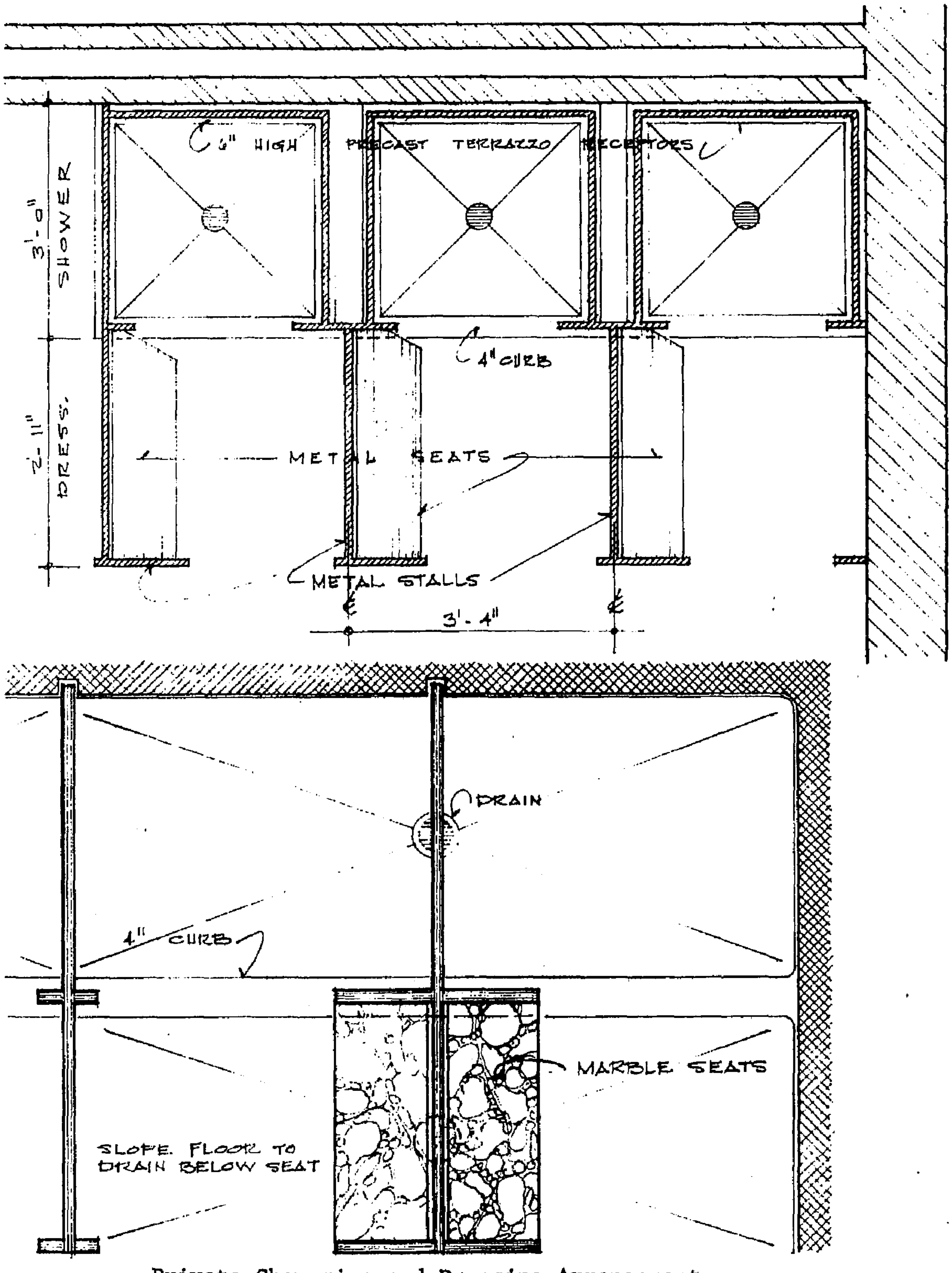
3. _Hanging racks for clothing_. Hanging racks for clothing in athletic dressing rooms are usually site-constructed. There are many designs, and wood is the favorite construction material. Hanging pegs for clothes are usually wood to prevent rusting. A small locker box is usually provided for each dressing space for keeping valuables. This type of athletic dressing system provides for maximum ventilation of athletic equipment as well as greater hanging space for football equipment.

Many hanging racks for clothing in athletic dressing rooms are pipes or racks for the hanging of metal multi-hook movable clothes hangers. This arrangement also provides maximum ventilation. The racks are sometimes enclosed by heavy wire structures which provide security.

4. _Individual shower stalls with dressing cubicles_. Individual shower stalls with dressing cubicles provide complete private showering and dressing. The shower stall was usually 3 feet by 3 feet, and it was separated from the dressing cubicle by a curtain. The dressing cubicle was usually 3 feet by 3 feet and was separated from the main dressing room by a curtain or by a door. Two arrangements of individual shower stall units are shown in Figure 15.

FIGURE 15

FLOOR PLAN VIEW OF TWO ARRANGEMENTS
OF INDIVIDUAL SHOWER STALLS



Private Showering and Dressing Arrangement.
Kettering Fairmont West High School, Ohio. Rial
T. Parrish Associates, Architects, Dayton, Ohio.

5. Semi-private showers. Semi-private showers are generally of two types. One type is basically a gang-shower arrangement with curtains separating the space around each shower head. The other type is basically a column-shower arrangement. Curtains are arranged to provide semi-private compartments around the central column which holds the shower heads.

6. Stall showers between individual dressing cubicles. Stall showers between individual dressing cubicles provide a single shower stall for each of two dressing cubicles. The units are particularly adapted to corner installation. The shower stall is placed in a corner with a dressing cubicle on each wall adjacent to the shower stall. Each of the dressing cubicles has an opening for entering the shower stall and another for moving into the dressing cubicle from the main dressing rooms. Privacy is usually provided by curtains over the openings.

7. Fixed vandal-proof shower heads. Fixed vandal-proof shower heads cannot be adjusted in height after original installation. The spray can be controlled in direction (height) within a limited area. Adjustment must be done with a tool because no part of the shower head is movable without one.

8. Column showers. Column showers are usually placed in shower rooms like gang shower rooms. The column showers have controls and shower heads around the column; therefore, they are adapted for installation on the medians of the shower rooms.

9. Large adjustable spray shower head. Large adjustable spray shower heads have part fittings that are movable. The system provides

a change in spray by moving a lever located on the side of the head. The heads may be conventional ball joint or rigid.

II. PHYSICAL EDUCATION ACTIVE CLOTHING STORAGE

Two-tier metal lockers were used in 51 (39.5 per cent) physical education dressing rooms. Wire baskets with clothing hanging racks were reported by 29 (22.5 per cent) of the architects, and wire baskets with metal lockers were used by 8 (6.2 per cent) of the schools. Full-length, 60 or 72-inch, metal lockers were reported by 21 (16.3 per cent) of the schools. Metal full-length lockers with box lockers were used in 20 (15.5 per cent) of the schools.

Architects' Responses to Questionnaires

Architects considered the initial cost of two-tier metal lockers and the cost of installing them to have been low, as Table XXVII indicates. Installation problems were considered to have been simple.

Cost of wire baskets with clothing racks was considered to have been low or average as was the cost of installation. Installation problems were said to have been simple or average.

All architects reported that the cost of the full-length lockers with box lockers and the cost of installation were average. Opinions differed, but installation problems experienced were considered to have been average.

Architects considered the cost of lockers and wire baskets as a physical education storage system to have been average. Cost of installation was reported to have been average or low. Installation problems were said to have been average.

TABLE XXVII

ARCHITECTS' RESPONSES TO QUESTIONS
REGARDING ACTIVE PHYSICAL EDUCATION
CLOTHING STORAGE IN 129 GYMNASIA

TYPES OF LOCKERS	COST OF UNIT			COST OF INSTALLATION			INSTALLATION PROBLEMS		
	Per Cent			Per Cent			Per Cent		
	low	average	high	low	average	high	simple	average	complex
Two-tier metal lockers	62.1	37.9	0	58.6	37.9	3.5	62.1	37.9	0
Wire baskets with clothing racks	42.9	57.1	0	42.9	57.1	0	42.9	57.1	0
Metal full-length lockers with box lockers	0	100	0	0	100	0	16.7	83.3	0
Wire basket with lockers	40.0	60.0	0	40.0	60.0	0	60.0	40.0	0
Metal full-length lockers	0	85.7	14.3	0	100	0	14.3	85.7	0

Cost of full-length lockers and cost of installation were reported as average. All architects reported average installation problems.

School Administrators' Responses to Questionnaires

School administrators considered two-tier lockers as excellent for physical education clothing storage, according to Table XVIII. Breakage of these units was not considered a problem by most administrators. Slightly more than 10 per cent of the administrators experienced large numbers of units out of use because of breakage. Maintaining units was reported to have been simple. Almost 20 per cent of the schools did not use locks on lockers.

The basket system with clothing racks was reported as a method of average efficiency for physical education clothing storage. Breakage of these units was not considered a problem although there were reports of excessive breakage. School administrators differed in responses related to ventilation qualities of the units, but a majority reported average ventilation. Maintenance problems were reported to have been simple or average as was operation of the system. Approximately 20 per cent of the schools did not use individual locks with this system.

The utility of full-length lockers with box lockers was considered to have been average by school administrators. Most of the reports indicated no breakage problems. Ventilation was reported to have been poor or average by almost all administrators. All of the schools used locks with the units.

The performance of wire baskets with lockers as physical education clothing storage was reported average. Breakage of these units was

TABLE XXVIII

SCHOOL ADMINISTRATORS' RESPONSES
TO QUESTIONS REGARDING PHYSICAL EDUCATION
ACTIVE CLOTHING STORAGE IN 129 GYMNASIA

TYPES OF UNITS	DOES JOB			OUT OF USE DUE TO BREAKAGE			VENTILATION			DIFFICULTY OF MAINTENANCE			EASE OF OPERATION			LOCKS USED	
	Per Cent			Per Cent			Per Cent			Per Cent			Per Cent			Per Cent	
	poor	average	excellent	some	average	excessive	poor	average	excellent	simple	average	complex	simple	average	complex	yes	no
Two-tier metal lockers	5.9	29.4	64.7	72.2	16.7	11.1	18.8	31.2	50.0	71.4	21.4	7.2	57.1	42.9	0	81.3	18.7
Wire baskets with clothing racks	6.2	56.3	37.5	53.4	33.3	13.3	12.5	68.8	18.7	52.9	47.1	0	43.8	56.2	0	78.6	21.4
Metal full-length lockers with box lockers	0	77.8	22.2	70.0	20.0	10.0	40.0	50.0	10.0	50.0	50.0	0	62.5	37.5	0	100	0
Wire baskets with lockers	20.0	60.0	20.0	60.0	40.0	0	50.0	33.3	11.7	25.0	75.0	0	60.0	40.0	0	100	0
Metal full-length lockers	0	10.0	90.0	70.0	10.0	20.0	36.4	36.4	27.2	70.0	30.0	0	60.0	40.0	0	85.5	14.3

not a problem. One-half of the administrators reported poor ventilation. Maintenance problems were considered to have been average. Operation of units was reported as simple. All schools used locks with the units.

School administrators believed full-length lockers to have been excellent for physical education clothing storage. Most of the administrators reported small amounts of breakage, but 20 per cent reported excessive breakage. Opinion related to ventilation was almost evenly divided among poor, average, and excellent. Approximately 15 per cent of the schools did not use locks.

Two-Tier Metal Lockers

Schools with a population below 400 students reported that 19 (42.2 per cent) used two-tier metal lockers for physical education dressing rooms. Lockers were used by 18 (40 per cent) of the middle-sized schools and by 14 (35.9 per cent) of the large schools.

Advantages found when using two-tier metal lockers for physical education clothing storage were: (1) they were low cost, (2) they provided space savings, and (3) they had good ventilation qualities. The problem of small size was listed by 38.9 per cent of the users. Poor ventilation was likewise a problem reported by some of the users.

Wire basket with Clothing Racks

Small schools reported that 14 (31.1 per cent) used wire baskets with clothing racks in physical education dressing rooms. This clothing storage system was reported by 7 (15.6 per cent) of the middle-sized schools, and by 8 (20.5 per cent) of the larger schools.

Advantages found when using the system were: (1) cut loss of clothing, (2) saved space, (3) aired clothing, and (4) eliminated need for individual locks. Disadvantages of the clothing storage system were listed as follows: (1) the baskets were too small, (2) the baskets were not permanent, (3) the baskets were not strong enough to prevent breakage, (4) the system needed a better locking method, and (5) the system required too much time to issue and store baskets.

Full-Length Metal Lockers with Box Lockers

Full-length metal lockers with box lockers in physical education rooms were reported by 8 (17.8 per cent) of the small schools and by 7 (15.6 per cent) of the middle-sized schools. Larger schools reported that 6 (15.4 per cent) used the units.

Advantages of the clothing storage system were: (1) saved space, (2) cut loss of clothing, and (3) cut down vandalism. Disadvantages found when using these units were: (1) too small, (2) not strong enough to prevent breakage, and (3) poor ventilation.

Wire Baskets with Lockers

Wire baskets with lockers were reported by 3 (6.7 per cent) of the small schools. The units were used by 2 (4.4 per cent) of the middle-sized schools and by 3 (7.7 per cent) of the larger schools.

Architects and school administrators reported the following advantages of the baskets with associated lockers: (1) cut vandalism, (2) operated easily, (3) used space efficiently, and (4) aired clothing. Disadvantages of the system were: (1) the baskets were too small, (2) the room had to be locked, and (3) the baskets and locker use had a high noise level.

Metal Full-Length Lockers

Small schools reported that one (2.2 per cent) used metal full-length lockers for physical education clothing storage. The units were used by 11 (24.4 per cent) of the middle-sized schools. Large schools reported that 8 (20.5 per cent) used the units.

Advantages found while using this system of clothing storage were: (1) it was a low cost system, (2) the lockers were easy to clean, (3) the system reduced loss of clothing, and (4) the system reduced vandalism. Disadvantages of these units were listed as follows: (1) not strong enough to prevent breakage, (2) poor ventilation, (3) poor locking arrangement, and (4) high noise level.

III. ATHLETIC ACTIVE CLOTHING STORAGE

Sixty (50.4 per cent) of the schools reported using two-tier metal lockers for athletic clothing storage. Metal full-length lockers were used by 34 (28.6 per cent) of the schools. A wire basket system with clothes hanging racks or with lockers were reported by 15 (12.6 per cent) of the schools. Hanging racks for clothing were used by 10 (8.4 per cent) of the schools.

Architects' Responses to Questionnaires

Cost of two-tier metal lockers for athletic dressing was reported to have been low or average as shown in Table XXIX. Cost of installation and installation problems were considered as average.

Architects considered the cost of metal full-length lockers and the cost of installing the units to have been average. Installation problems were reported to have been average.

TABLE XXIX

ARCHITECTS' RESPONSES TO QUESTIONS REGARDING ATHLETIC ACTIVE CLOTHING STORAGE IN 119 GYMNASIA

TYPES OF LOCKERS	COST OF UNIT			COST OF INSTALLATION			INSTALLATION PROBLEMS		
	Per Cent			Per Cent			Per Cent		
	low	average	high	low	average	high	simple	average	complex
Two-tier metal locker	52.8	44.4	2.8	25.0	68.8	6.2	37.5	62.5	0
Metal full-length locker	11.8	88.2	0	11.8	88.2	0	29.4	70.6	0
Wire baskets	36.4	63.6	0	20.0	80.0	0	50.0	50.0	0
Hanging racks for clothing	100	0	0	66.7	33.3	0	66.7	33.3	0

The cost of wire baskets was believed to have been average as was the cost of installation. Opinions related to installation problems were equally divided between simple and average. The reports indicated that problems of installation were those of installing basket storage areas.

All architects who installed clothing hanging racks in athletic dressing rooms considered them a low cost system. Most of the architects reported cost of installation to have been low. Installation problems were reported to have been simple.

School Administrators' Responses to Questionnaires

As Table XXX indicates, two-tier metal lockers for athletic dressing rooms were reported as excellent or average for clothing storage. Breakage among these units was not a problem. Opinions related to ventilation were divided among the three responses. Most of the reports indicated average or excellent ventilation. The units were believed to have been easy to maintain. The school administrators differed on estimations of ease of operation among the three responses, simple, average, and complex. Approximately 90 per cent of the schools used locks with the units.

The utility of metal full-length lockers in athletic dressing rooms did not achieve a consensus. Approximately 50 per cent of school administrators indicated excellent service from the units. Breakage, regarding full-length lockers, was not a problem. Reports related to ventilation were almost equally divided among the three responses, poor, average, and excellent. Maintenance problems were classed as simple or average as were questions related to ease of

TABLE XXX

SCHOOL ADMINISTRATORS' RESPONSES TO QUESTIONS REGARDING ATHLETIC ACTIVE CLOTHING STORAGE IN 119 GYMNASIA

TYPES OF UNITS	DOES JOB			OUT OF USE DUE TO BREAKAGE			VENTILATION			DIFFICULTY OF MAINTENANCE			EASE OF OPERATION			LOCKS USED	
	Per Cent			Per Cent			Per Cent			Per Cent			Per Cent			Per Cent	
	poor	average	excellent	some	average	excessive	poor	average	excellent	simple	average	complex	simple	average	complex	yes	no
Two-tier metal lockers	0	39.1	60.9	94.4	5.6	0	13.0	43.5	43.5	60.0	40.0	0	52.6	36.8	10.5	90.5	9.5
Metal full-length lockers	13.8	31.0	55.2	85.7	14.3	0	27.6	41.4	31.0	51.7	48.3	0	58.1	41.9	0	92.6	7.4
Wire baskets	10.0	20.0	70.0	71.4	28.6	0	10.0	60.0	30.0	25.0	75.0	0	55.6	44.4	0	70.0	30.0
Hanging racks for clothing	0	33.3	66.7	100	0	0	0	0	100	66.7	33.3	0				33.3	66.7

operation. More than 92 per cent of the schools used lockers with the units.

Most administrators considered wire baskets as an excellent system for athletic dressing, but there were reports of average or poor experiences. Breakage was not a problem. Ventilation of the units was believed to have been average by most of the administrators although there were reports of poor as well as excellent. Average maintenance problems were experienced. The system was reported to have been simple to operate. Thirty per cent of the schools did not use locks on the units.

The utility of hanging racks for athletic dressing rooms was reported to have been excellent or average. Breakage was not a problem. Ventilation was excellent. Maintenance of the units was either simple or average. One-third of the schools used locks with the units; the locks were used on individual valuables boxes.

Two-Tier Metal Lockers

Small schools reported that 23 (57.5 per cent) used two-tier metal lockers for athletic active clothing storage. The units were reported by 20 (41.4 per cent) of the middle sized schools and by 17 (44.8 per cent) of the larger schools.

Advantages of two-tier metal lockers were listed as follows: (1) they made more lockers available, (2) they were maintenance free, (3) they were durable, and (4) they had good ventilation. Disadvantages of these units were: (1) they had poor ventilation, (2) they were too small, (3) they were noisy, and (4) they made the locker rooms too crowded.

Metal Full-Length Lockers

Small schools reported that 4 (10 per cent) used metal full-length lockers in athletic dressing rooms. The units were used by 17 (41.4 per cent) of the middle-sized schools and by 13 (34.2 per cent) of the large schools.

Advantages of these units were: (1) they were maintenance free, (2) they provided individual storage, (3) there was more space inside lockers, and (4) they had good ventilation. Disadvantages of the units were listed as follows: (1) they took more space than some other systems, (2) they were noisy, (3) they had poor ventilation, and (4) they were not 100 per cent effective.

Wire Baskets

Wire baskets for athletic dressing rooms were reported in combination with lockers and with hanging racks. It was not possible to determine the exact proportion because 24.5 per cent of the architects reported "wire baskets." Small schools reported that 9 (22.5 per cent) used wire baskets in athletic dressing rooms. The units were used by 2 (4.9 per cent) of the middle-sized schools and by 4 (10.5 per cent) of the larger schools.

Advantages of wire baskets for athletic dressing were: (1) they saved storage space, (2) they kept area fresh, (3) they had good ventilation, (4) they were low cost, and (5) they were durable. Disadvantages of the wire baskets were listed as follows: (1) they had poor ventilation, (2) they were not permanent, (3) the room had to be locked, and (4) they were too small.

Hanging Racks for Clothing

Hanging racks for clothing as a dressing system for athletics were used in 4 (10 per cent) of the small schools and in 2 (4.9 per cent) of the middle-sized schools. The system was used by 4 (10.5 per cent) of the large schools.

Advantages found when using the racks were as follows: (1) convenient, (2) complete ventilation, (3) individual valuables security, (4) low noise level, and (5) ample hanging space. The lack of security was the only disadvantage mentioned. One school administrator stated that the racks were made of wood; therefore, rusting was not a problem.

Other Active Clothing Storage Consideration

Gang and private storage. Two schools reported the use of large, well ventilated lockers in the center of the area. Each locker was large enough to hold clothing or equipment of ten or more athletes. Individual lockers were placed around the perimeter of the dressing area, providing a well ventilated secure area for athletic clothing.

Locker ventilation. There were three methods of ventilating lockers that proved effective. First, expanded metal was used on the doors and sides of lockers. Second, round regularly punched holes were placed in the doors and sides of lockers. Third, there were square regularly punched holes on doors and sides of lockers.

Locker air plenum. One architect suggested an arrangement of lockers so that the backs of the lockers form an air plenum. This system of air space served in ventilating and heating the dressing room as well as furnishing extra air circulation for locker ventilation.

IV. GIRLS' SHOWERING FACILITIES

The standards for girls' showering facilities as recommended by the National Facilities Conference are as follows:

> For girls, approximately 90 per cent of the showers should be the gang-type and 10 per cent the individual-type with related dressing cubicles. Where there is extensive use of showers by women, it may be desirable to increase the number of individual showers and dressing cubicles.[1]

Individual shower stalls with associated dressing cubicles for private showering and dressing were reported by 44 (32.8 per cent) of the schools. Gang showers plus private shower stalls and dressing cubicles were used in 36 (26.9 per cent) of the schools. Semi-private curtain arrangements and gang type showers were reported by 24 (17.9 per cent) of the schools. Stall showers between individual dressing cubicles were reported by 6 (4.5 per cent) of the schools. Twenty-four (17.9 per cent) gang shower arrangements were reported.

Architects' Responses to Questionnaires

Two-thirds of the architects considered individual shower stalls with associated dressing cubicles as average in initial cost. There were reports of low and high cost, as Table XXXI indicates.

Twenty per cent of the architects considered the cost of gang showers plus private shower stalls with associated dressing cubicles to have been low; a similar percentage reported high cost. Responses to questions of installation cost and installation problems followed

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[1]Planning Areas and Facilities for Health, Physical Education and Recreation (Chicago: The Athletic Institute; Washington, D.C.: American Association for Health, Physical Education, and Recreation, 1965), p. 91.

TABLE XXXI

ARCHITECTS' RESPONSES TO QUESTIONS REGARDING GIRLS' SHOWERING FACILITIES IN 134 GYMNASIA

TYPES OF SHOWERS	COST OF UNIT			COST OF INSTALLATION			INSTALLATION PROBLEMS		
	Per Cent			Per Cent			Per Cent		
	low	average	high	low	average	high	simple	average	complex
Individual shower stalls in the dressing cubicles	11.1	66.7	22.2	5.6	72.2	22.2	33.3	61.1	5.6
Gang showers plus private shower stalls with dressing cubicles	20.0	60.0	20.0	20.0	70.0	10.0	30.0	60.0	10.0
Gang showers	30.0	60.0	10.0	40.0	60.0	0	40.0	60.0	0
Semi-private showers	50.0	50.0	0	33.3	55.6	11.1	42.9	57.1	0
Stall showers between individual dressing cubicles	0	66.7	33.3	0	100	0	0	100	0

this pattern.

The initial cost of gang showers was reported to have been average, although there were reports of low and high cost. Cost of installation of the shower system was considered to have been average. Installation problems were average.

Opinions related to cost of semi-private showers were equally divided between low and average. Slightly more than one-half of the architects reported the cost of installation to have been average. Other architects reported low installation cost. Installation problems were said to have been average.

Most of the architects reported that stall showers between individual dressing cubicles were average in initial cost. There were reports of high initial cost. All of the architects reported average cost of installation and average installation problems.

School Administrators' Responses to Questionnaires

Slightly more than 50 per cent of the school administrators rated private shower stalls as excellent facilities for girls' showers, as reported in Table XXXII. Most of the remaining administrators reported that the units were average, but there were some reports of poor service. Maintaining private showers for girls was considered as not difficult.

School respondents considered gang showers in addition to private shower stalls with dressing cubicles to have been an excellent arrangement. Maintaining showering facilities did not present serious problems.

TABLE XXXII

SCHOOL ADMINISTRATORS' RESPONSES TO QUESTIONS
REGARDING GIRLS' SHOWERING FACILITIES
IN 134 GYMNASIA

TYPES OF SHOWERS	DOES JOB			DIFFICULTY OF MAINTENANCE			OUT OF USE FOR MAINTENANCE		
	Per Cent			Per Cent			Per Cent		
	poor	average	excellent	simple	average	complex	little	average	large
Individual shower stalls with dressing cubicles	5.3	42.1	52.6	63.2	36.8	0	78.9	21.1	0
Gang showers plus private shower stalls with dressing cubicles	0	25.0	75.0	56.3	43.7	0	100	0	0
Gang showers	0	33.3	66.7	44.4	44.4	22.2	88.8	11.1	11.1
Semi-private showers	0	41.7	58.0	66.7	25.0	0	83.3	16.7	0
Stall showers between individual dressing cubicles	0	50.0	50.0	0	100	0	50.0	50.0	0

School administrators reported excellent service from gang showering systems. There was a lack of consensus in reporting on the difficulty of maintenance. Loss of use because of maintenance was reported to have been little.

Administrators divided their opinions of the utility of semi-private showering facilities between average and excellent. Maintaining the showering facilities did not present serious problems.

Opinions related to the utility of stall showers between individual dressing cubicles were equally divided between average and excellent. All of the school people considered the difficulty of maintaining the units as average. Opinions related to loss of use because of maintenance were equally divided between little and average.

Individual Shower Stalls with Dressing Cubicle

Schools with enrollment below 400 students reported that 18 (38.3 per cent) installed individual shower stalls with associated dressing cubicles for girls' showering facilities. The units were used by 15 (32 per cent) of the middle-sized schools and by 10 (25 per cent) of the large schools.

Advantages of individual shower and dressing stalls were: (1) attractive, (2) low maintenance, (3) durable, (4) complete privacy, and (5) low cost. Disadvantages of these units were listed as follows: (1) they required more space than gang showers, (2) they were high cost, (3) they were subject to vandalism, and (4) they were difficult to supervise.

Gang Showers Plus Private Shower Stalls with Dressing Cubicles

Gang showers plus private stalls and associated dressing cubicles were reported by 9 (19.2 per cent) of the smaller schools. The showering system was employed by 14 (29.8 per cent) of the middle-sized schools and by 14 (35 per cent) of the large schools.

Advantages of the system were listed as follows: (1) economical and private showering, (2) low maintenance, and (3) attractive. Disadvantages of the gang and private showering systems were: (1) girls objected to gang showering, (2) the units were subject to vandalism, and (3) supervision was difficult.

Gang Showers

Gang showers were reported by 11 (23.4 per cent) of the small schools and by 6 (12.7 per cent) of the middle-sized schools. Seven (17.5 per cent) of the larger schools used the facilities.

Advantages of this type of showering facilities for girls were: (1) these were low cost facilities, (2) girls became less self-conscious, and (3) supervision was easy. Girls' objections to gang showers were the only disadvantages reported. Several administrators indicated that girls did not shower because only gang showers were available.

Semi-private Showers

Semi-private showering facilities utilize curtains. Small schools reported that 7 (14.9 per cent) used semi-private showering facilities for girls. The facilities were reported by 8 (17 per cent) of the middle-sized schools and by 9 (22.5 per cent) of the large schools.

Advantages experienced when using semi-private showering for girls were as follows: (1) they were low cost, (2) they provided limited privacy, and (3) they were easy to supervise. Disadvantages of these facilities were: (1) they took up more space than gang showers, (2) they were subject to vandalism, (3) repair of controls were complex, and (4) they did not provide privacy.

<u>Stall Showers between Individual Dressing Cubicles</u>

Stall showers between individual dressing cubicles were reported by 2 (4.2 per cent) of the small schools. The units were used by 4 (8.5 per cent) of the middle-sized schools. The larger schools did not report this type of showering unit.

Advantages listed by architects and school administrators were: (1) they provided some privacy, (2) they allowed savings in initial cost, and (3) they were durable. Disadvantages of these facilities were listed as follows: (1) took more space than gang showers, (2) were difficult to supervise, (3) did not provide complete privacy, and (4) were subject to vandalism.

V. SHOWER HEADS

Conventional adjustable shower heads were used by 62 (46.3 per cent) of the schools. Fixed vandal-proof shower heads were reported by 36 (26.9 per cent) of the schools. Column showers were considered as a shower head system and were used by 20 (14.9 per cent) of the schools. Sixteen (11.9 per cent) of schools reported the use of large adjustable spray shower heads. Because of differences in showering arrangements for boys and girls, 7.5 per cent of the schools reported using two types of shower heads. It was not always possible to associate the data with a specific shower head; therefore, the first shower head listed and the related data were used in each instance.

Architects' Responses to Questionnaires

Architects reported that conventional adjustable shower heads were average in initial cost, but there were reports of high or low costs, according to the information presented in Table XXXIII. Responses related to cost of installation followed the same pattern. Installation problems were said to have been average or simple.

The cost of fixed vandal-proof shower heads was reported to have been average, but almost 40 per cent of the architects reported high cost. Installation costs were considered to have been average; problems experienced during installation were reported as average.

Most of the architects reported the cost of column showers to have been low or average, but there were some reports of high cost. Cost of installing units was reported as low. Problems experienced during installing the column showers were said to have been average.

All architects reported that cost of large adjustable spray shower heads was average. Installation problems were also said to have been average by most of the architects.

School Administrators' Responses to Questionnaires

There was not a consensus when the school administrators responded to the questions of utility of the conventional adjustable shower heads, according to Table XXXIV. There were varying responses to questions of difficulties experienced in maintaining the units. Administrators

TABLE XXXIII

ARCHITECTS' RESPONSES TO QUESTIONS REGARDING SHOWER HEADS IN 134 GYMNASIA

TYPES OF SHOWER HEADS	COST OF UNIT Per Cent			COST OF INSTALLATION Per Cent			INSTALLATION PROBLEMS Per Cent		
	low	average	high	low	average	high	simple	average	complex
Conventional adjustable	12.0	76.0	12.0	12.0	84.0	4.0	32.0	68.0	0
Fixed vandal-proof	7.7	53.8	38.5	7.7	84.6	7.7	23.1	69.2	7.7
Column shower	50.0	40.0	10.0	60.0	40.0	0	40.0	60.0	0
Large adjustable spray	0	100	0	0	100	0	25.0	75.0	0

TABLE XXXIV

SCHOOL ADMINISTRATORS' RESPONSES TO QUESTIONS REGARDING SHOWER HEADS IN 134 GYMNASIA

TYPES OF SHOWER HEADS	DOES JOB Per Cent			DIFFICULTY OF MAINTENANCE Per Cent			OUT OF USE FOR MAINTENANCE Per Cent		
	poor	average	excellent	simple	average	complex	little	average	large
Conventional adjustable	14.7	39.5	45.8	43.6	41.7	14.7	64.5	20.8	14.7
Fixed vandal-proof	5.9	41.2	52.9	56.2	43.8	0	81.2	18.8	0
Column shower	12.5	50.0	37.5	25.0	75.0	0	75.0	25.0	0
Large adjustable spray	28.6	14.3	57.1	57.1	14.3	28.6	42.8	28.6	28.6

reported little loss of use because of maintenance, although there were reports of average as well as large time losses.

Slightly more than one-half of the school administrators recorded excellent service from fixed vandal-proof shower heads, but there were reports of average or poor utility. Difficulties experienced in maintaining shower heads were reported as simple or average. Loss of use because of maintenance was said to have been little.

Fifty per cent of the school administrators reported average utility of column showers. There were reports of excellent service from these units. Difficulties found during maintaining the showers were estimated as average. Loss of use because of maintenance was identified as little.

Large adjustable spray shower heads were considered to have been excellent. More than one-fourth of the administrators reported poor utility of shower heads. Simple problems of maintenance were reported: there were also reports of complex problems. There was not a consensus related to the loss of use because of maintenance.

Adjustable Shower Heads

Conventional adjustable shower heads were reported by 28 (59.6 per cent) of the small schools. Shower heads were used by 21 (44.8 per cent) of the middle-sized schools and by 13 (32.5 per cent) of the large schools.

Advantages of the conventional adjustable shower heads were: (1) they were low cost, (2) they had no time or temperature limit, (3) they were easy to clean, and (4) the spray had uniformity. Disadvantages were listed as follows: (1) they clogged easily requiring frequent maintenance, (2) they leaked, (2) they were subject to vandalism, and (4) they were easily broken.

Fixed Vandal-proof Shower Heads

Fixed vandal-proof shower heads were used by 7 (14.9 per cent) of the small schools. Shower heads were reported by 14 (29.8 per cent) of the schools in the middle population group and by 15 (37.5 per cent) of the large schools.

Advantages found when using fixed vandal-proof shower heads were reported as follows: (1) they were vandal-proof, (2) they needed tools for resetting spray, and (3) they had no time or temperature limit. Disadvantages of these heads were: (1) they were not adjustable in height, (2) the parts were hard to obtain, and (3) they clogged easily.

Column Showers

Column showers were reported by 9 (19.1 per cent) of the smaller schools. The showering system was used by 6 (12.7 per cent) of the middle-sized schools and by 5 (12.5 per cent) of the large schools.

Advantages of the column showers were: (1) low cost, (2) more students accommodated in the space, and (3) single control. All of the disadvantages reported were related to vandalism and breakage.

Large Adjustable Spray Shower Heads

Large adjustable spray shower heads were used by 3 (6.4 per cent) of the smaller schools and by 6 (12.7 per cent) of the middle-sized schools. Large schools reported that 7 (17.5 per cent) used this type of shower head.

Advantages of the units were related to the uniformity of the spray and the ease of cleaning the head. Disadvantages of the shower heads were: (1) leaky showers and (2) subject to vandalism.

VI. SUMMARY

Dressing Room Clothing Storage

Two-tier metal lockers for active physical education clothing storage were used more often than other lockers. They were reported to have been satisfactory except that the size was considered small. Full-length metal lockers received many reports of excellence.

More than one-half of the small schools used two-tier lockers for athletic dressing. Middle-sized schools and large schools reported two-tier and full-length lockers more often. Opinion varied as to the effectiveness of the lockers. The response of excellence was applied to the effectiveness of athletic clothing hanging racks.

Girls' Showering Facilities

Individual shower stalls with associated dressing cubicles for private showering and dressing were reported more often than other girls' showering facilities. The system did not prove to have been completely satisfactory because of difficulties of supervision. Vandalism was also a serious problem with the units.

Gang showers plus private shower stalls with dressing cubicles were reported to have been satisfactory with most respondents. Objections to gang showers for girls received the strongest reaction from administrators. Some difficulties were experienced when supervising private shower compartment.

Shower Heads

Conventional adjustable shower heads were reported in use more often than others. Fixed vandal-proof shower heads were less frequently used, as were column showers and large adjustable spray shower heads. None of the heads proved to have been entirely satisfactory. Vandalism and leakage were problems experienced by most school people.

CHAPTER VI

MAIN GYMNASIUM SEATING AND OPERABLE PARTITIONS

Main gymnasium seating should be designed to accommodate spectators in relationship to the largest regularly attending crowd. However, "under no circumstances should the program facilities be cut so that spectators' accommodations can be financed."[1] It was not an objective of this survey to study the number of persons that can be accommodated. The objective was to survey the types of facilities used to seat spectators.

Architects and school administrators consider very carefully the number of teaching stations when designing a gymnasium. A survey of the equipment used to divide the main gymnasium area and the small rooms into multiple teaching stations was one of the objectives of this study.

I. DEFINITIONS OF TERMS

1. Folding bleachers. Various names have been applied to folding bleachers, such as roll out and telescopic. Normally the back row of the seating arrangement is attached to a wall. When open, the seats stretch toward the area to be viewed. When folded, they add to the thickness of the wall. Many variations may be found in accessories, such as seat backs, padded seats, padded seat backs, and rails.

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[1] Planning Areas and Facilities for Health, Physical Education, and Recreation (Chicago: The Athletic Institute; Washington, D.C.: American Association for Health, Physical Education, and Recreation, 1965), p. 91.

Many design features are available, such as closed decks, varying spacing, various methods of rolling the bleachers, and varying methods of storage.

2. Reverse folding bleachers. Reverse folding bleachers and forward fold bleachers are synonymous. The bleachers fold toward the area viewed from the open bleachers; thus when they are closed, a wall of folded bleachers separates two areas.

3. Movable grandstands. Other names applied to movable grandstands are portable folding bleachers and mobile bleachers. All features of the units are similar to the conventional folding bleachers except for floor or wall attachment. Movable grandstands may be moved freely as units within the gymnasium. Utility is found in their ability to provide spectator seating for various events such as basketball, boxing, wrestling, and gymnastics.

4. Fabric curtain partitions. Fabric curtain partitions for the main gymnasium areas may be traverse or pull-up type. They may be power or manually operated. The usual design is canvas duck on the bottom and twine netting at the top.

5. Folding partitions. There are many designs of folding partitions. They are made of various combinations of wood and fabric. When they are heavy, they require a strong suspension and roller system and moved by power.

II. MAIN GYMNASIUM SEATING

Four primary systems of seating were reported. Folding bleachers were used by 88 (65.7 per cent) of the schools. Permanent seating was reported by 18 (13.4 per cent) of the schools. A combination of folding bleachers and permanent seating was used by 16 (12 per cent) of the schools. Folding bleachers and movable grandstands were reported by 10 (7.5 per cent) of the schools. Two other systems were reported but involved very small numbers of the participants in this study. One school reported the use of fiberglass molded theater seats, and another reported a steel grandstand arrangement.

Architects' Responses to Questionnaires

Architects considered the initial cost of folding bleachers to have been average, as shown in Table XXXV. Similar reports were recorded when considering the questions of cost of installation. Most architects reported average installation problems.

Architects divided evenly the estimates of initial cost of permanent seating between low and average. Permanent seating were considered to have had average cost of installation. The reports related to problems of installation also showed an even division between simple and average.

According to Table XXXV architects considered folding bleachers and permanent seating to have had average initial cost and cost of installation. They also reported problems of average difficulty regarding installation.

All of the architects reported that folding bleachers and movable grandstands had average initial and installation cost. Average installation problems were indicated.

School Administrators' Responses to Questionnaires

Most of the school administrators reported excellent utility of

TABLE XXXV

ARCHITECTS' RESPONSES TO QUESTIONS REGARDING MAIN GYMNASIUM SEATING OF 132 SCHOOLS

TYPES OF SYSTEMS	COST OF UNIT			COST OF INSTALLATION			INSTALLATION PROBLEMS		
	Per Cent			Per Cent			Per Cent		
	low	average	high	low	average	high	simple	average	complex
Folding bleachers	0	91.7	8.3	0	94.4	5.6	25.6	66.7	7.7
Permanent seating	50.0	50.0	0	42.9	57.1	0	50.0	50.0	0
Folding bleachers and permanent seating	0	100	0	0	100	0	28.6	71.4	0
Folding bleachers and movable grandstand	0	100	0	0	100	0	0	100	0

folding bleachers as reported in Table XXXVI. They did not experience loss of bleacher use because of repairs. Cost of maintenance was estimated to have been average. There were small problems of maintenance; there were some reports of no problems or some of complex problems. A consensus concerning ease of operation of the folding bleachers was not achieved; however, most of the administrators reported simple or average ease of operation of the units. Folding bleachers were moved an average of 2.6 times each week.

School administrators evenly divided their opinions of the utility of permanent seating between excellent and average. There was some breakage of the seats, but most administrators reported that this was not a problem. All of the administrators reported average cost of maintaining the seating system. Few problems of maintenance were experienced by most administrators.

Administrators believed the combination folding bleachers and permanent seating to have been an excellent system. Normally this system of seating did not cause problems in maintenance, but there were some reports of complex problems. The folding bleachers were usually rated as easy to operate; schools reported moving the folding bleachers an average of 1.4 times each week.

School administrators reported that folding bleachers and movable grandstands were excellent for spectator seating. All of the administrators agreed that this system was durable. Most reports indicated average cost of maintenance. Ease of operating the seating system was usually rated as simple. Some administrators reported average or difficult operating conditions. Units were moved an average of 2.9 times each week.

TABLE XXXVI

SCHOOL ADMINISTRATORS' RESPONSES TO QUESTIONS
REGARDING MAIN GYMNASIUM SEATING IN 132 SCHOOLS

TYPE OF SEATING	DOES JOB Per Cent			OUT OF USE DUE TO BREAKAGE Per Cent			COST OF MAINTENANCE Per Cent			DIFFICULTY OF MAINTENANCE Per Cent			EASE OF OPERATION Per Cent			NUMBER OF TIMES MOVED PER WEEK
	poor	average	excellent	none	little	large	low	average	high	none	little	complex	simple	average	hard	
Folding bleachers	6.1	30.3	63.6	72.7	27.3	0	16.7	80.0	3.3	28.1	68.8	3.1	42.4	48.5	9.1	2.6
Permanent seating	0	50.0	50.0	66.7	33.3	0	0	100	0	33.3	66.7	0				
Folding bleachers and permanent seating	0	40.0	60.0	77.8	22.2	0	20.0	80.0	0	0	90.0	10.0	87.5	12.5	0	1.4
Folding bleachers and movable grandstand	0	35.7	64.3	100	0	0	20.0	73.3	6.7	28.7	71.4	0	66.7	26.6	6.7	2.9

Folding Bleachers

Folding bleachers were reported in use by 25 (53.2 per cent) of the smaller schools. The bleachers were used by 32 (68.1 per cent) of the middle-sized schools and by 31 (77.5 per cent) of the large schools.

Advantages of folding bleachers were listed as follows: (1) they made the entire floor area usable, (2) they were easy to operate, (3) they were easy to maintain, and (4) they were more comfortable with back rests. Disadvantages of folding bleachers were as follows: (1) there were some difficulty with electrical wiring, (2) they required additional maintenance, (3) they were uncomfortable, (4) spectators were difficult to supervise, (5) the facility took time to put into place, and (6) plastic wheels broke.

Three architects designed movable railings that could be placed in front of folding bleachers, which aided in controlling crowds. Made in light, easily installed sections, they were successful.

As has been previously reported, many of the gymnasia included in this study were within the main high school complex. This arrangement led to a close proximity of some of the gymnasia and auditoriums. Two schools had mutual balcony seating for the gymnasium and auditorium in addition to an extra teaching station. Bunker and Savage, Architects, of Augusta, Maine, described in a letter to the researcher one of these systems:

> This area is a floor, one story above the ground floor. There is a folding partition which can be moved to place this space either in the gymnasium or the auditorium and there are sectional folding bleachers which can be folded up and rotated so as to face either the auditorium or the gymnasium.[2]

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[2]Letter from Bunker and Savage, Architects, Augusta, Maine, June 8, 1966.

The other school reported a similar arrangement but used reverse fold bleachers.

Permanent Seating

Permanent seating was used in 15 (31.9 per cent) of the gymnasia serving small schools. This type of spectator seating was used by 2 (4.3 per cent) of the middle groups of schools. One (2.5 per cent) of the larger schools reported permanent spectator seating.

Advantages reported when permanent seating was used for spectators were as follows: (1) it provided storage underneath, (2) it was low in cost, (3) it was easy to maintain, and (4) it was easy to control crowds. Disadvantages of this type of seating were listed as follows: (1) space was not usable for other purposes and (2) it was uncomfortable.

Folding Bleachers and Permanent Seating

Small schools reported that 3 (6.4 per cent) used a combination of folding bleachers and permanent seating to accommodate spectators. This seating arrangement was used by 8 (17 per cent) of the middle-sized schools and by 5 (12.5 per cent) of the large schools.

Advantages reported when using this system were concerned with the versatility of the system and the relatively low maintenance requirements. Disadvantages of the system were as follows: (1) there was some difficulty with the electric wiring, (2) two men were required to operate the bleachers, (3) there was some difficulty in keeping aisles clear of spectators, and (4) it was uncomfortable.

Folding Bleachers and Movable Grandstands

Folding bleachers and movable grandstands were used for spectator seating by 3 (6.4 per cent) of the small schools. The system of seating was reported by 4 (8.5 per cent) of the middle group of schools and by 3 (7.5 per cent) of the large schools.

Advantages of the folding bleachers and movable grandstands were listed as follows: (1) versatile seating arrangements, (2) low cost, (3) strong and durable, and (4) can be placed close to action. Disadvantages of this system were: (1) difficult grandstand storage and (2) difficult to supervise.

III. OPERABLE PARTITIONS

Operable partitions in the main gymnasium areas were reported by 53 (39.5 per cent) of the schools. As previously reported many gymnasia did not have directly associated small rooms, such as classrooms, and only 8 (11.4 per cent) of the schools reported operable partitions within the small rooms.

Nine (19.2 per cent) of the small schools reported operable partitions in main gymnasium areas. The partitions were used by 26 (55.5 per cent) of the middle-sized schools and by 18 (45 per cent) of the large schools.

Operable Partitions in the Main Gymnasium Area

Architects' responses to questionnaires. Architects generally reported that the cost of fabric curtain partitions and installation was low, according to Table XXXVII. There were also reports of high and average initial cost.

Initial cost of folding partitions was reported to have been average or high. Architects generally reported average cost of installation.

TABLE XXXVII

ARCHITECTS' RESPONSES TO QUESTIONS REGARDING OPERABLE PARTITIONS IN 53 MAIN GYMNASIUM AREAS

TYPES OF SYSTEMS	COST OF UNIT			COST OF INSTALLATION			INSTALLATION PROBLEMS		
	Per Cent			Per Cent			Per Cent		
	low	average	high	low	average	high	simple	average	complex
Fabric curtain partitions	75.0	8.3	16.7	75.0	16.7	8.3	66.7	25.0	8.3
Folding partitions	0	58.3	41.7	8.3	75.0	16.7	25.0	58.3	16.7

School administrators' responses to questionnaires. School administrators were divided evenly on opinions of the effectiveness of fabric curtain partitions between average and excellent, as shown in Table XXXVIII. Administrators reported no loss or little loss of use of partitions because of breakage, but approximately 10 per cent reported large amounts of loss. Cost of maintenance was considered as low while there was not a consensus on the questions of difficulty of maintenance; most administrators reported easy operation of the partitions. Fabric curtain partitions were moved an average of 4.8 times each week.

Service from folding partitions was said to have been excellent or average. A majority of respondents reported no loss of use; others reported either little or large losses of use because of breakage. Cost of maintenance was low, but some administrators reported average or high cost. Problems experienced during maintaining the partitions were described as average, low, and complex, indicating no agreement. Ease of operation was considered to have been simple or average. Folding partitions were moved an average of 5.8 times each week.

Fabric curtain partitions. There were two operating procedures for fabric curtain partitions reported; however, it was not possible to determine the exact number of each type because of incomplete reporting. First, some of the partitions were raised to the ceiling. Second, other fabric curtain partitions were divided and drawn like traverse drapes. Both manual and power methods of moving the partitions were reported.

TABLE XXXVIII

SCHOOL ADMINISTRATORS' RESPONSES TO QUESTIONS
REGARDING OPERABLE PARTITIONS IN
53 MAIN GYMNASIUM AREAS

TYPE OF PARTITION	DOES JOB			OUT OF USE DUE TO BREAKAGE			COST OF MAINTENANCE			DIFFICULTY OF MAINTENANCE			EASE OF OPERATION			NUMBER OF TIMES MOVED PER WEEK
	Per Cent			Per Cent			Per Cent			Per Cent			Per Cent			Average
	poor	average	excellent	none	little	large	low	average	high	none	little	complex	simple	average	hard	
Fabric curtain partitions	0	50.0	50.0	45.5	45.5	9.0	63.6	36.4	0	27.3	45.4	27.3	81.8	18.2	0	4.8
Folding partitions	0	31.2	68.8	56.3	37.5	6.2	75.0	12.5	12.5	31.2	50.0	18.8	77.8	22.2	0	5.8

Fabric curtain partitions were used by 4 (44.4 per cent) of the small schools that reported having main gymnasium partitions. Similarly, 12 (46.2 per cent) of the middle-sized schools and 7 (38.9 per cent) of the large schools reported having fabric curtain partitions.

Advantages of the partitions were reported as follows: (1) they were low in cost, (2) they cut down class noise, and (3) they required small storage space. Disadvantages of the partitions were listed as follows: (1) they had some mechanical problems, (2) they were easily torn, (3) they were not sound proof, (4) they had high maintenance requirements, and (5) they swayed with air currents.

Folding partitions. Folding partitions were used by 5 (55.6 per cent) of the smaller schools that reported using partitions. Similarly, the gymnasium partitions were reported by 13 (50 per cent) of the middle-sized schools and by 10 (55.5 per cent) of the larger schools.

Advantages of folding partitions for main gymnasium areas were as follows: (1) low inter-class noise, (2) easy to operate, and (3) attractive. Disadvantages of the partitions were listed as follows: (1) there were some mechanical problems, (2) there was some deflection over long spans, and (3) they were sometimes difficult to repair.

Coil partitions. Coil partitions are so called because they are stored on a power spindle and are drawn from the storage by power driven cable. Two schools reported using the partitions. One of the schools used this partition to divide the main gymnasium into two teaching stations. The other school used a coil partition to close-off the stage, which was at one end of the gymnasium.

The coil partitions provide a flexible partition capable of being curved and even cornered. It is coiled in a compartment off the floor area. A disadvantage of this partition as reported by one schools was its slow movement.

Operable Partitions in the Small Rooms

Because of the small percentage of small room partitions, the data were considered to have been inconclusive. There were two types of small room operable partitions reported: (1) accordion fold partitions and (2) folding partitions. Accordion fold partitions in small rooms were not reported by small schools. This type of partition was reported by one (2.1 per cent) of the middle-sized schools and by 4 (10 per cent) of the larger schools.

Accordion fold partitions were reported to have been light weight, easy to operate, attractive, and low in cost. The partitions were considered to have had poor sound-blocking qualities.

Folding partitions were used by one (2.1 per cent) of the small schools. The partitions were reported by one (2.1 per cent) of the schools in the middle population group and by one (2.5 per cent) of the large schools. No comments as to the advantages or disadvantages of the partitions were made.

IV. SUMMARY

Main Gymnasium Seating

Of the basic four systems of spectator seating all but one included folding bleachers. The exception was the permanent seating arrangement which was reported to have been a satisfactory system. The more attractive aspects were in the areas of maintenance. Lack of versatility and loss of floor space were reported disadvantages of this system of seating.

Folding bleachers as the exclusive means of spectator seating was the system used most often. They were reported to have been satisfactory. Problems related to moving the bleachers were the main detracting features.

Versatility of folding bleachers was the advantage reported most often. There were definite indications that folding bleachers could solve most seating problems as well as provide for the comfort of the spectators. Degrees of comfort were directly related to cost of units. More seating space, leg rooms, back rest, and comfort padding could be added to the basic system.

Operable Partitions

Two primary operable partitions were reported to have been used in main gymnasium areas. Folding partitions were used by more than one-half of all schools. Advantages of the partitions were that they provided a partition similar to a permanent wall. Problems experienced when using the folding partitions were related to weight; consequently problems of moving the units were reported.

Other partitions used in the main gymnasium were types of fabric curtain. This partition provided satisfactory service in most cases reported. The main disadvantages of the partitions were related to thinness. Adaptability and low cost provided most of the reasons for the success of fabric partitions.

Coil walls were reported by two schools with the advantages cited as versatility. Accordion fold walls were not reported by schools of this study.

Folding partitions and accordion fold partitions were used in the small rooms. The reports were not in sufficient number for conclusions to be drawn.

CHAPTER VII

SWIMMING FACILITIES

A total of 14 participants in this study reported swimming facilities that were associated with gymnasia. There were four swimming pools reported by schools with an enrollment below 400. Schools with an enrollment of 400 - 1,200 students reported three. Seven of the larger schools reported swimming facilities. All of the facilities were indoors.

I. DEFINITIONS OF TERMS

1. Swimming pool tank. The swimming pool tank is that structure which has the prime responsibility of holding the water. The materials cited for use in this study were concrete, steel, and aluminum. Ceramic tile, natural clay tile, paint, glazed brick, and asphalt coating on external surfaces were used to enhance the service of the tanks.

2. Diatomaceous earth filters. Fossilized skeletons of microscopic water plants are called diatoms. These skeletons form an extremely porous framework of nearly pure silica. Deposits in over 10,000 different shapes and types were laid down in prehistoric times.[1]

> Diatomaceous earth is deposited on filter elements within a filter shell. Some operate under pressure, others operate under a vacuum. The diatomite coating is removed periodically and

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[1]Attmore E. Griffin, "Dictionary of Pool Terms," Swimming Pool Age, 40:26, August, 1966.

recoated. Coagulants are not normally used with this type of filter.[2]

3. Sand filters.[3] There are three basic types of sand filters--slow, rapid and high rate. Slow sand filters depend upon a mass of plant organisms as well as the sand for filtering qualities. Because of manual cleaning and slow filter rate this system has been replaced by the use of rapid sand filters.

Rapid rate pressure stratified sand filters are used for swimming pools. This system is cleaned by back washing. Materials other than sand have been used successfully in the systems, especially hard coal of the correct hardness, fracture content, size and shape.

High rate sand filters, the latest development in the field, require less filter area than rapid rate filters since they achieve 20 gallons an hour for each square foot of filter area. Less filter area requires less time and water for backwash.

4. Chlorinator. A chlorinator introduces a chemical, chlorine, into the swimming water system in the proportions to disinfect new contaminants introduced by bathers. Chlorine is consumed by the bacteria it kills. It is necessary to add chlorine continuously in order to maintain a sterile condition.

> Chlorine for swimming pool disinfection is available in several forms: calcium or sodium hypochlorite or compressed gas in pressurized cylinders. The hypochlorites are manually mixed with water and fed with solution feeders. The liquid chlorine is dispensed as a gas in water solution.[4]

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[2]Thomas M. Jackson, Jr., "Several Tips are Given for Using Diatomite," Swimming Pool Data and Reference Annual, 33:52, 1966.

[3]Ellis Udwin, "A Concise Comparison of Filtration Methods," Swimming Pool Data and Reference Annual, 33:60-64, 173, 1966.

[4]For Swimming Pools (Providence, Rhode Island: BIF Division, The New York Air Brake Company, 1966), Reference Number 1860, pp. 22-3.

5. pH. pH is the term most frequently used to describe the degree of alkalinity or acidity of water. The actual meaning is the potential of electricity for positive hydrogen ions. The pH value of distilled water is 7.0. pH values below 7.0 indicate acidity. pH values above 7.0 indicate alkalinity. The desired range for pool water is from 7.2 to 7.6.[5]

II. CERAMIC TILE SWIMMING POOLS

Eleven ceramic tile swimming pools were reported. The bases for the ceramic tile had several variations. Nine of the pools had concrete tanks. One of these had a concrete slab base for the pool floor and concrete block base for the pool walls. One architect reported a metal tank for the ceramic tile floor and walls. One architect emphasized waterproofing the structural slab under the tile.

Seven of the pools used ceramic tile for pool walls and floors. One architect reported the use of glazed brick for the pool walls. Three architects used conventional ceramic tile for the pool walls and natural clay tile for the pool floors.

School administrators, with the exception of two respondents, reported draining and refilling the pools one time during the year. One drained and refilled the pool two times each year, and another indicated that the pool was not drained and refilled, but was cleaned daily. All school administrators reported that pools were used extensively and were never without water except when being cleaned.

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[5]Key to the Perfect Swimming Pool. (Pleasantville, New York: Paragon Swimming Pool Co., Incorporated, 1965), p. 26.

Seepage did not appear to have been a problem, as all school administrators except two reported no seepage. Two administrators reported small amounts of seepage. Cleaning of ceramic tile pools was considered to have been easy or average in difficulty.

Architects reported average or high cost of ceramic tile swimming pools. Architects generally emphasized sanitary conditions and ease in cleaning qualities of ceramic tile. The beauty of ceramic tile was also mentioned by architects.

III. CONCRETE, ALUMINUM, AND STEEL SWIMMING POOLS

One concrete pool was reported. The architect indicated that it was a low cost pool. He stated that the concrete surfaces were comparatively rough. The school administrator concerned considered this to have been an excellent pool with only small seepage problems and average difficulties with cleanliness.

One aluminum pool was reported. It was reported to have been a low cost, durable pool. All responses indicated that it was an excellent swimming pool.

Reporting on the installation and use of an aluminum pool, Kahoe wrote that it was outstanding. He stated that aluminum made a moderate price, low maintenance, and rust-free swimming pool.[6]

Two steel swimming pools were reported but one could not be included in this study because of incomplete information. The prefabricated tank was site assembled, asphalt coated on the exterior surface, and carefully painted on the interior surface. The cost of

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[6]Howard Kahoe, "Aluminum Swimming Pool," The American City, 169-173, July, 1958.

the pool was considered to have been average. It was reported to have been an excellent pool.

IV. SWIMMING POOL WATER CONDITIONING

One architect reported that there was no water conditioning equipment used in the operation of the pool for which he supplied information. Seven of the pools had diatomaceous earth filters and six had sand filters. Both systems were reported to have been excellent. One architect indicated the diatomaceous earth filters were required by local building codes.

Armburst recommended:

> Vacuum diatomite filters should be used particularily in the heavily loaded or large pools because:
> 1. Vacuum filters can be of corrosion-proof construction.
> 2. They are easier and less costly to install.
> 3. They are completely open to view. They are not a "black box."
> 4. They can be more readily cleaned.
> 5. They can be more readily disassembled and maintained.
> 6. They provide long filter runs.
> 7. Power costs are low-approximating those of sand filters.[7]

No chemical system was reported for seven of the swimming pools. Four chlorinators were reported, two of which were hypochlorinators. One chlorine and pH correction comparator was used. One system of chlorine and acid feeders was reported. Bromine treatment was used by one school.

V. ACOUSTICAL AND MOISTURE PROBLEMS

Acoustical and moisture problems associated with indoor swimming pools were not included in the planning of this study; however, several

[7]Henry N. Armburst, "The Operation and Applications of Vacuum D.E. Filtration," Swimming Pool Age, 40:20, July, 1966.

architects considered the problems worthy of mention, and so they have been included.

Ceramic tile walls or wainscot were reported to have made the solution of acoustical and moisture problems more difficult. Two solutions were the use of painted concrete block walls and the use of cork walls. The first solution was not completely successful, and there was no comment related to the success of the second. Another architect approached the problem by using a folded ceiling arrangement that also served as air plenum, as Figure 16 illustrated.

In Figure 17 are shown the elevations of another approach to the solution of acoustical and moisture problems. Brick screen, sound baffles, and recessed ceiling lighting provided an efficient acoustical arrangement.[8]

VI. SUMMARY

Most of the swimming pools were made of ceramic tile on concrete tanks. Concrete, aluminum, and steel swimming pools were reported. All of the 13 pools in this study were reported to have been excellent.

Diatomaceous earth and sand filters were reported to have been excellent filters. Various systems for chlorinating water were used. All systems were reported to have been excellent.

Acoustical and moisture problems of indoor swimming pools were mentioned by several architects. Additional research is needed concerning the planning and building of indoor swimming pools.

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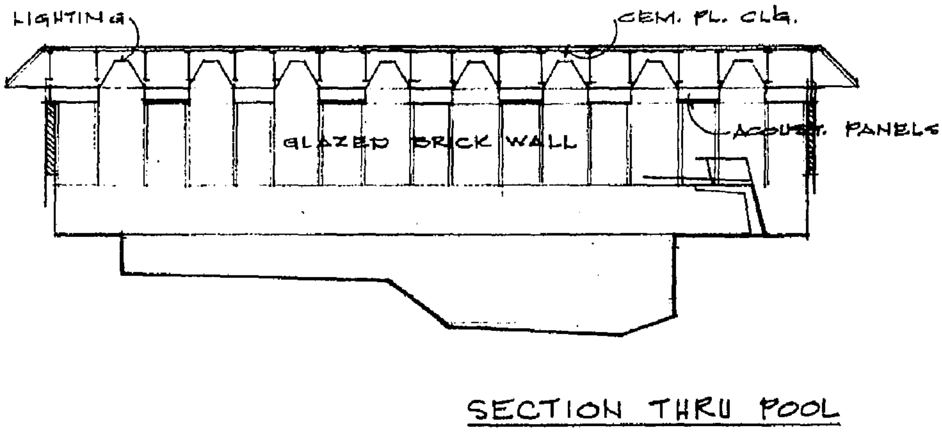
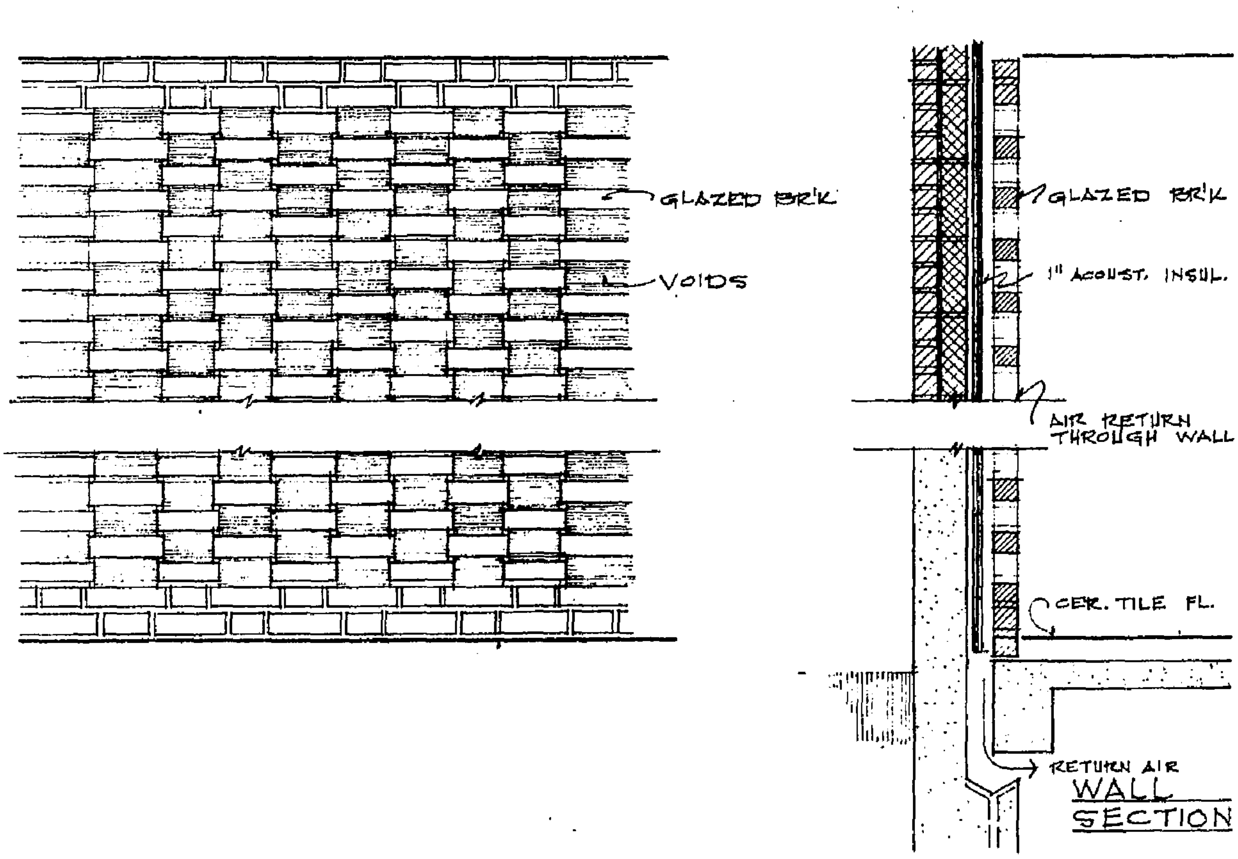
[8]Peter P. Jacobi, "New School Solves Echo Problems," Swimming Pool Age 38:46, January, 1964.

FIGURE 17

SECTIONS OF WALL SCREEN AND ACOUSTICAL DESIGNED CEILING APPROACH TO SOLVING MOISTURE AND ACOUSTICAL PROBLEMS OF AN INDOOR POOL*

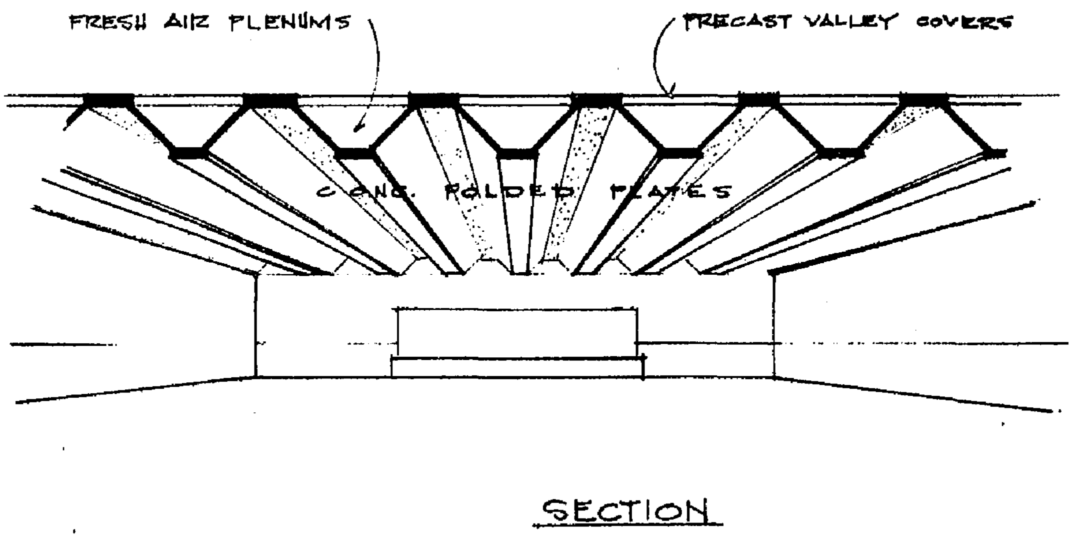


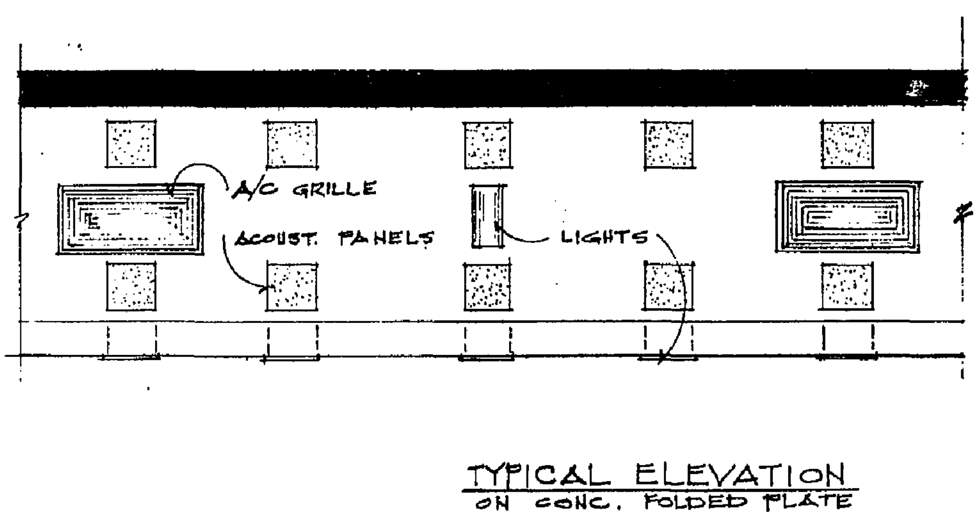


* See footnote 3.

FIGURE 16

SECTIONS OF FOLDED PLATE AND FRESH AIR APPROACH TO SOLVING MOISTURE AND ACOUSTICAL PROBLEMS OF AN INDOOR POOL





Concrete Folded Plate Sections. Oak Creek Senior High School, Wisconsin. Zarse and Zarse, Incorporated, Architects, Milwaukee, Wisconsin.

CHAPTER VIII

GYMNASIUM COMPONENTS

School administrators and architects were asked to express their opinions as to the components of a complete gymnasium. They were asked to indicate those components considered to be necessary, those components considered to be highly desirable but not required, and those components not considered necessary for an ideal gymnasium. The responses were divided according to the population groups.

I. NECESSARY COMPONENTS

Small Schools

In Table XXXIX are shown gymnasium components that were considered absolutely essential to an ideal gymnasium by more than 50 per cent of the school administrators of schools with a population below 400 students. The percentage of architects' opinions was arranged adjacent to the percentage of the school administrators' responses. There were similarities of opinions on the following components: (1) athletic equipment storeroom, general; (2) athletic equipment storeroom, boys; (3) shower room, gang, boys; and (4) staff showering facilities connected to office.

There was considerable divergence of opinion on the following components: (1) apparatus room; (2) athletic equipment storeroom, girls; (3) physical education equipment storeroom, general; (4) physical education equipment storeroom, boys; (5) physical education equipment storeroom, girls; (6) athletic dressing room, boys; and

TABLE XXXIX

GYMNASIUM COMPONENTS THAT WERE CONSIDERED NECESSARY TO THE IDEAL GYMNASIUM BY 41 ADMINISTRATORS OF SCHOOLS WITH POPULATIONS BELOW 400 STUDENTS AND CORRESPONDING OPINIONS OF ARCHITECTS

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
Apparatus room	57.9	36.8	5.3	0	4.3	95.7
Athletic equipment storeroom, general	76.9	10.3	12.8	72.0	16.0	12.0
Athletic equipment storeroom, boys	74.4	12.8	12.8	92.0	0	8.0
Athletic equipment storeroom, girls	64.1	23.1	12.8	0	43.5	56.5
Physical education equipment storeroom, general	69.2	12.8	18	0	39.1	60.9
Physical education equipment storeroom, boys	71.7	18.0	10.3	4.3	26.1	69.6
Physical education equipment storeroom, girls	61.5	20.5	18.0	13.6	36.4	50.0
Heavy equipment storeroom	66.7	30.7	2.6	29.2	33.3	37.5
Athletic dressing room, boys	64.1	23.1	12.8	13.0	30.4	56.5
Physical education dressing room, boys	66.7	23.1	10.3	17.4	39.1	43.5

Table XXXIX (continued)

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
Physical education dressing room, girls	76.3	13.2	10.5	27.7	40.9	36.4
Janitor's equipment rooms	76.9	15.4	7.7	26.1	34.8	39.1
Shower room, gang, boys	85.4	7.3	7.3	54.2	25.0	20.8
Shower room, gang, girls	58.5	12.2	29.3	43.5	43.5	13.0
Concession room	58.5	29.3	12.2	25.0	45.0	30.0
Ticket sales office	53.7	34.1	12.2	30.0	50.0	20.0
Rest rooms in physical education and/or athletic dressing rooms, girls	85.4	2.4	12.2	20.0	35.0	45.0
Rest rooms in physical education and/or athletic dressing rooms, boys	90.2	2.4	7.3	32.0	16.0	52.0
Ladies' staff office	51.4	27.0	21.6	13.6	45.5	40.9
Men's staff office	62.2	27.0	10.8	33.3	50.0	16.7
Staff showering facilities connected to office	66.7	30.6	2.8	50.0	7.7	42.3
Staff toilet facilities connected to office	67.6	27.0	5.4	40.0	48.0	12.0
Retractable seats in main gym	58.3	22.2	19.4	40.0	36.0	24.0

(7) rest rooms in physical education and/or athletic dressing rooms, boys. Fifty per cent or more of the architects indicated that the above components were not needed in the ideal gymnasium.

Middle-Sized Schools

School administrators' and architects' opinions related to the components of ideal gymnasia serving schools with populations of 400 to 1,200 students were similar concerning the following: (1) athletic equipment storerooms, general; (2) athletic equipment storerooms, boys; (3) multi-purpose dressing rooms, boys; (4) shower room, mass, boys; and (5) staff toilet facilities connected to office. This is shown in Table XL.

Opinions related to the following components showed large divergence: (1) apparatus room; (2) wrestling room; (3) physical education storeroom, general; (4) physical education dressing room, boys; (5) physical education dressing room, girls; (7) athletic dressing room, boys; (8) physical education dressing room, boys; (9) physical education dressing room, girls; (10) field maintenance equipment room; (11) concessions; (12) multi-purpose rest rooms, public and student; (13) public and student rest rooms, separate; and (14) ladies staff office. Fifty per cent or more of the architects believed that the above components were not needed in the ideal gymnasium.

Large Schools

School administrators of schools with a population above 1,200 were very conscious of the need for gymnasia with components suited to broad programs. Forty-one separate gymnasium components were believed absolutely essential to the ideal gymnasium by more than 50 per cent of

TABLE XL

GYMNASIUM COMPONENTS THAT WERE CONSIDERED NECESSARY TO THE IDEAL GYMNASIUM BY 46 ADMINISTRATORS OF SCHOOLS WITH POPULATIONS OF 400 TO 1,200 STUDENTS AND CORRESPONDING OPINIONS OF ARCHITECTS

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
Apparatus room	64.4	35.6	0	0	9.1	90.9
Classrooms, boys	70.5	25.0	6.8	5.0	55.0	40.0
Classrooms, girls	55.6	33.3	11.1	10.5	63.2	26.3
Classrooms, health	64.4	28.9	6.7	33.3	33.3	33.3
Wrestling room	57.8	33.3	8.9	50.0	0	50.0
Athletic equipment storeroom, general	72.7	11.4	15.9	85.7	4.8	9.5
Athletic equipment storeroom, boys	82.2	15.6	2.2	85.7	4.8	9.5
Athletic equipment storeroom, girls	77.8	13.3	8.9	15.8	42.1	42.1
Physical education equipment storeroom, general	65.9	13.6	20.5	0	45.0	55.0
Physical education storeroom, boys	88.9	6.7	4.4	0	25.0	75.0

Table XL (continued)

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
Physical education storeroom, girls	80.0	11.1	8.9	15.0	10.0	75.0
Heavy equipment storeroom	82.2	15.6	2.2	47.6	23.8	28.6
Multi-purpose dressing room, boys	57.8	22.2	20.0	50.0	15.0	35.0
Multi-purpose dressing room, girls	60.0	22.2	17.8	15.0	20.0	65.0
Athletic dressing rooms, boys	82.2	11.1	6.7	5.3	26.3	68.4
Physical education dressing rooms, boys	86.7	8.9	4.4	10.5	21.1	68.4
Physical education dressing rooms, girls	84.4	8.9	6.7	11.1	11.1	77.8
Janitor's equipment room	86.7	8.9	4.4	23.8	42.9	33.3
Field maintenance equipment room	51.1	44.4	4.4	27.3	22.7	50.0
First aid room, boys	53.3	33.3	13.3	47.7	47.4	5.3
Shower room, mass, boys	95.7	2.2	2.2	52.6	42.1	5.3
Shower room, individual, girls	60.9	28.3	10.9	38.9	50.0	11.1
Foyer	50.0	34.1	15.9	0	66.7	33.3
Concessions	54.3	32.6	13.0	0	22.2	77.8
Ticket sales	58.7	30.4	10.9	40.0	40.0	20.0
Multi-purpose restrooms, public and student	57.8	13.3	28.9	0	13.3	86.7
Public and student restroom, separate	63.0	23.9	13.0	6.7	20.0	73.3
Restrooms in physical education and athletic dressing rooms, girls	95.7	2.2	2.2	5.9	52.9	41.2

Table XL (continued)

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
Restrooms in physical education and athletic dressing rooms, boys	97.8	0	2.2	16.7	38.9	44.4
Ladies' staff office	59.1	15.9	25.0	10.5	36.8	52.6
Men's staff office	67.4	20.9	11.6	26.3	26.3	47.4
Staff shower room connected to office	75.0	20.5	4.5	45.0	20.0	35.0
Staff toilet facilities connected to office	77.3	15.9	6.8	55.0	25.0	20.0
Retractable seats in main gymnasium	66.7	21.4	11.9	31.6	42.1	26.3
Multi-purpose swimming pool	64.9	27.0	8.1	26.3	42.1	31.6

the school administrators as shown in Table XLI. General agreement by the architects was indicated on the following components: (1) athletic equipment storeroom, general; (2) athletic equipment storeroom, boys; (3) heavy equipment storeroom; (4) shower room, mass, boys; (5) men's staff office; (6) physical education staff office, ladies; (7) athletic staff office, men; and (8) staff toilet facilities connected to offices.

Fifty per cent or more of the architects believed that the following components were not needed in the ideal gymnasium: (1) apparatus room; (2) physical education storeroom, girls; (3) physical education dressing rooms, girls; (4) first aid room, girls; (5) foyer; (6) concession; (7) multi-purpose rest rooms, public and student; and (8) public and student rest rooms, separate.

II. DESIRABLE COMPONENTS

Small Schools

In Table XLII are shown gymnasium components that were considered necessary or desirable to the ideal gymnasium by more than 67 per cent of the school administrators of schools with a population below 400 students. Architects expressed similar opinions about the following components: (1) classroom, health; (2) multi-purpose dressing rooms, boys; (3) field maintenance equipment room; (4) first aid room, boys; (5) shower room, individual, girls; (6) body development room; (7) games rooms; (8) classrooms, multi-purpose; (9) remedial or modified activity room; (10) visual aid room; (11) four-wall handball courts; (12) multi-purpose swimming pool; (13) partition (folding) in main gymnasium.

TABLE XLI

GYMNASIUM COMPONENTS THAT WERE CONSIDERED NECESSARY TO THE IDEAL GYMNASIUM BY 34 ADMINISTRATORS OF SCHOOLS WITH POPULATIONS ABOVE 1,200 STUDENTS AND CORRESPONDING OPINIONS OF ARCHITECTS

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
Apparatus room	63.6	36.4	0	5.6	5.6	88.9
Classrooms, boys	57.6	36.4	6.1	5.9	70.6	23.5
Classrooms, girls	51.5	42.4	6.1	23.5	64.7	11.8
Classrooms, health	51.6	35.5	12.9	23.5	76.5	0
Wrestling room	60.6	36.4	3.0	29.4	29.4	41.2
Athletic equipment storeroom, general	84.8	6.1	9.1	61.1	27.8	11.1
Athletic equipment storeroom, boys	97.0	3.0	0	88.9	11.1	0
Athletic equipment storeroom, girls	81.8	15.1	3.0	5.9	76.5	17.6
Physical education storeroom, general	78.8	6.1	15.1	5.9	64.7	29.4
Physical education storeroom, boys	90.9	9.1	0	0	58.8	41.2

TABLE XLI (continued)

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
Physical education storeroom, girls	84.8	12.1	3.0	27.8	22.2	50.0
Heavy equipment storeroom	84.8	9.1	6.1	52.9	23.5	23.5
Athletic dressing room, boys	90.9	6.1	3.0	38.9	38.9	22.2
Physical education dressing rooms, boys	84.8	12.1	3.0	11.8	41.2	47.1
Physical education dressing rooms, girls	87.9	6.1	6.1	5.9	41.2	52.9
Janitor's equipment room	97.0	3.0	0	21.1	47.4	31.6
Field maintenance equipment room	77.4	19.4	3.2	38.9	55.6	5.6
First aid room, general	51.5	27.3	21.2	23.5	29.4	47.1
First aid room, boys	71.9	25.0	3.1	38.9	55.6	5.6
First aid room, girls	53.1	28.1	18.8	0	11.8	88.2
Shower room, mass, boys	97.1	2.9	0	50.0	44.4	5.6
Shower room, mass, girls	60.6	21.2	18.2	44.4	44.4	11.1
Shower room, individual, girls	64.7	26.5	8.8	11.1	55.6	33.3
Foyer	70.6	26.5	2.9	0	41.2	58.8
Concession	50.0	41.2	8.8	18.8	31.2	50.0

TABLE XLI (continued)

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
Ticket sales office	61.8	32.4	5.8	38.9	44.4	16.7
Multi-purpose restrooms, public and student	53.1	31.3	15.6	0	29.4	70.6
Public and student restrooms, separate	61.8	26.5	11.7	5.9	29.4	64.7
Restrooms in physical education and athletic dressing rooms, girls	85.3	8.8	5.9	11.1	50.0	38.9
Restrooms in physical education and athletic dressing rooms, boys	94.1	5.9	0	12.5	50.0	37.5
Ladies' staff office	69.1	9.1	21.2	17.6	52.9	27.4
Men's staff office	75.8	9.1	15.1	55.6	38.9	5.6
Director's office plus separate staff offices	50.0	31.3	18.7	31.6	57.9	10.5
Physical education staff office, men	65.6	18.7	15.6	21.1	57.9	21.1
Physical education staff office, ladies	80.0	10.0	10.0	55.6	22.2	22.2
Athletic staff office, men	71.0	16.1	12.9	66.7	22.2	11.1
Staff shower facility connected to offices	84.4	12.5	3.1	44.4	27.8	27.8
Staff toilet facility connected to offices	87.5	12.5	0	52.7	47.4	0

TABLE XLI (continued)

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
Partition (folding) in main gymnasium	62.5	25.0	12.5	44.4	44.4	11.1
Retractable seating in main gymnasium	71.9	12.5	15.6	27.8	66.7	5.6
Multi-purpose swimming pool	65.5	27.6	6.9	27.8	38.9	33.3

TABLE XLII

GYMNASIUM COMPONENTS THAT WERE CONSIDERED NECESSARY AND DESIRABLE TO THE IDEAL GYMNASIUM BY 41 ADMINISTRATORS OF SCHOOLS WITH POPULATIONS BELOW 400 STUDENTS AND CORRESPONDING OPINIONS OF ARCHITECTS

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
Classrooms, boys	28.2	43.6	28.2	8.7	43.5	47.8
Classrooms, health	33.3	48.7	18.0	40.0	40.0	20.0
Wrestling room	28.2	46.1	25.6	26.1	17.4	56.5
Multi-purpose dressing room, boys	47.4	21.0	31.6	52.0	16.0	32.0
Multi-purpose dressing room, girls	43.2	29.7	27.0	8.7	26.1	65.2
Athletic dressing room, girls	35.9	33.3	30.7	34.8	30.4	34.8
Field maintenance equipment room	47.3	42.1	10.5	28.6	47.6	23.8
First aid room, general	41.5	34.1	24.4	13.0	17.4	69.6
First aid room, boys	39.0	46.3	14.6	45.8	37.5	16.7
First aid room, girls	34.1	43.9	22.0	4.3	8.7	87.0
Shower room, individual, girls	48.8	31.7	19.5	34.8	39.1	26.1
Foyer	36.6	41.5	21.9	9.1	36.4	54.5
Weight-lifting room	39.0	46.3	14.6	15.0	10.0	75.0
Body development room	29.3	46.3	24.4	37.5	54.2	8.3

Table XLII (continued)

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
Public and student restrooms, separate	48.8	36.6	14.6	0	15.0	85.0
All rooms multi-purpose	22.2	52.8	25.0	44.0	12.0	44.0
Game rooms	23.1	56.4	20.5	58.3	33.3	8.3
Classrooms, multi-purpose	20.5	50.4	23.1	66.7	29.2	4.2
Remedial or modified activity room	10.3	59.0	30.7	52.0	28.0	20.0
Visual aids rooms	18.0	53.8	28.2	39.1	34.8	26.1
Conference room	14.6	53.7	31.7	0	43.5	56.5
Four-wall handball courts	9.8	63.4	26.8	45.8	45.8	8.3
All unobstructed walls smooth for rebounding	33.3	52.8	13.9	12.5	45.8	41.7
Multi-purpose pool	30.0	50.0	20.0	34.8	43.5	21.7
Partition (folding) in main gymnasium	33.3	41.7	25.0	47.8	43.5	8.7

Administrators and architects had diverging opinions concerning the following components, that is, more than 50 per cent of the architects considered these components as not necessary in gymnasia serving this size school: (1) wrestling room; (2) multi-purpose dressing rooms, girls; (3) first aid, general; (4) first aid room, girls; (5) foyers; (6) weight-lifting room; (7) public and student rest rooms, separate; and (8) conference room.

Middle-Sized Schools

According to Table XLIII, more than 67 per cent of the administrators and architects of gymnasia serving schools with a population of 400 to 1,200 students indicated that the following components were either necessary or desirable to ideal gymnasia: (1) games rooms; (2) classrooms, multi-purpose; (3) body development room; (4) conference room; (5) four-wall handball courts; (6) physical education staff office, ladies; and (7) athletic staff office, men. More than 50 per cent of the architects considered the following components as not needed in an ideal gymnasium: (1) first aid room, girls, and (2) weight-lifting room.

Large Schools

More than 67 per cent of the administrators and architects for schools with populations above 1,200 considered the following gymnasium components as needed or desirable as shown in Table XLIV, in this ideal gymnasium: (1) games rooms; (2) classrooms, multi-purpose; (3) rhythm rooms; (4) remedial or modified activity room; (5) multipurpose dressing room, boys; (6) athletic dressing rooms, girls; (7) visual aid rooms; (8) body development room; (9) four-wall handball courts; (10) partition (folding) in classrooms; and (11) diving pool.

TABLE XLIII

GYMNASIUM COMPONENTS THAT WERE CONSIDERED NECESSARY AND DESIRABLE TO THE IDEAL GYMNASIUM BY 46 ADMINISTRATORS OF SCHOOLS WITH POPULATIONS OF 400 TO 1,200 STUDENTS AND CORRESPONDING OPINIONS OF ARCHITECTS

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
All rooms multi-purpose	45.5	40.9	13.6	47.6	14.3	38.1
Games rooms	31.1	62.2	6.7	54.5	22.2	22.7
Classrooms, multi-purpose	26.7	62.2	11.1	60.9	26.1	13.0
Remedial and modified activity room	26.7	44.4	28.9	42.9	23.8	33.3
Athletic dressing rooms, girls	40.0	28.9	31.1	31.6	21.1	47.4
Visual aids room	28.9	51.1	20.0	35.0	25.0	40.0
First aid room, girls	41.3	32.6	26.1	5.6	5.6	88.9
Weight-lifting room	37.0	50.0	13.0	0	0	100.0
Body development room	37.0	45.7	17.4	83.3	11.1	5.6
Conference rooms	32.6	43.5	23.9	0	73.7	26.3
Four-wall handball courts	8.7	76.1	15.2	36.8	52.6	10.5
Director's office plus separate staff office	42.7	31.0	26.2	21.1	42.1	36.8
Individual offices	31.0	38.1	31.0	45.0	20.0	35.0
Physical education staff offices, ladies	46.5	20.9	32.6	55.0	20.0	25.0
Athletic staff office, men	32.6	37.2	30.2	57.9	21.1	21.1

TABLE XLIV

GYMNASIUM COMPONENTS THAT WERE CONSIDERED NECESSARY AND DESIRABLE TO THE IDEAL GYMNASIUM BY 34 ADMINISTRATORS OF SCHOOLS WITH POPULATIONS ABOVE 1,200 STUDENTS AND CORRESPONDING OPINIONS OF ARCHITECTS

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
All rooms multi-purpose	34.5	37.9	27.6	52.6	0	47.4
Games rooms	12.1	75.8	12.1	57.9	15.8	26.3
Classrooms, multi-purpose	33.3	60.6	6.1	50.0	44.4	5.6
Rhythm rooms	12.1	66.7	21.2	33.3	55.6	5.6
Remedial or modified activity room	36.4	48.5	15.1	38.9	44.4	16.7
Multi-purpose dressing room, boys	45.5	30.3	24.2	72.2	16.7	11.1
Multi-purpose dressing room, girls	39.4	48.5	12.1	11.8	47.1	41.2
Athletic dressing rooms, girls	33.3	42.4	24.2	29.4	47.1	23.5
Visual aids rooms	18.7	68.8	12.5	42.1	31.6	26.3
Weight-lifting room	42.4	48.5	9.1	5.9	29.4	64.7
Body development room	34.4	59.4	6.2	40.0	38.9	11.1
Conference rooms	14.7	73.5	11.8	0	64.7	35.3
Four-wall handball courts	6.1	72.7	21.2	58.8	41.2	0
All unobstructed walls smooth	42.4	54.5	3.0	15.8	42.2	42.1

Table XLIV (continued)

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
Partition (folding) in classrooms	16.1	58.1	25.8	52.9	23.5	23.5
Partition (folding) in specialty rooms	27.6	51.7	20.7	0	61.1	38.9
Diving pool	16.7	54.2	29.1	100	0	0

Weight-lifting rooms were considered as not needed in gymnasia by 64.7 per cent of the architects. This was the only component on which school administrators and architects responded with divergent opinions.

III. COMPONENTS THAT ARE NOT NEEDED

Small Schools

In Table XLV are shown the components that were considered as not needed in gymnasia by more than 33 per cent of the administrators of schools with a population below 400 students. Twelve of the 24 components were considered as not needed by more than 50 per cent of the school administrators.

Nine of the components were considered as not needed by more than 33 per cent of the architects. Five of the components were considered as not needed by more than 50 per cent of the architects. A total of 15 of the components were considered as necessary or highly desirable by more than 67 per cent of the architects. Outstanding examples of the divergent opinions between school administrators and architects are responses concerning diving pools, which 92 per cent of the architects considered as necessary, and permanent seating in the main gymnasium which 84.6 per cent of the architects considered as necessary to an ideal gymnasium.

Middle-Sized Schools

Twenty-one of the components were considered as not needed by more than 33 per cent of the administrators of schools with a population of 400 - 1,200 students, according to Table XLVI. Eleven of the components

TABLE XLV

GYMNASIUM COMPONENTS THAT WERE CONSIDERED NOT NEEDED IN THE IDEAL GYMNASIUM BY 41 ADMINISTRATORS OF SCHOOLS WITH POPULATIONS BELOW 400 STUDENTS AND CORRESPONDING OPINIONS OF ARCHITECTS

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
Classrooms, girls	21.0	39.5	39.5	0	82.6	17.4
Rhythm room	10.3	46.1	43.6	52.0	40.0	8.0
Work shop	10.3	43.6	46.1	4.5	31.8	63.6
Multi-purpose restrooms	43.9	17.1	39.0	5.0	15.0	80.0
Squash courts	2.4	41.5	56.1	12.5	66.7	20.8
Staff offices, men and women	20.0	20.0	60.0	17.4	47.8	34.8
Director's office plus staff office	11.1	36.1	52.8	8.3	16.7	75.0
Director's office plus separate staff office for men and women	19.4	33.3	47.2	8.3	16.7	75.0
Physical education staff office, men	20.0	37.1	42.9	12.5	58.3	29.2
Physical education staff office, ladies	25.7	40.0	34.3	45.5	27.3	27.3
Individual offices	11.4	31.4	57.1	72.0	4.0	24.0
Athletic staff office, ladies	17.1	25.7	57.1	65.4	15.4	19.2

Table XLV (continued)

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
Athletic head coach office, separate	8.3	38.9	52.8	54.2	16.7	29.2
Athletic staff office, men	22.9	37.1	40.0	54.2	29.2	16.7
Doctor's office	5.7	14.3	80.0	56.5	21.7	21.7
Nurses' office	18.9	35.1	45.9	46.2	34.6	19.2
Dentist's office	2.9	5.7	91.4	64.0	0	36.0
Partition (folding) in classrooms	2.9	48.6	48.6	56.5	26.1	17.4
Partition (folding) in specialty rooms	2.9	58.8	38.2	4.2	62.5	33.3
Permanent seats in main gymnasium	18.2	24.2	57.6	84.6	7.7	7.7
Combination permanent and retractable seats in main gymnasium	25.0	18.8	56.2	0	33.3	66.7
Seven-foot constant depth pool	14.8	11.1	74.1	20.8	54.2	25.0
Four-foot constant depth pool	11.1	22.2	66.7	13.0	39.1	47.8
Diving pool	15.4	38.5	46.1	92.0	4.0	4.0

TABLE XLVI

GYMNASIUM COMPONENTS THAT WERE CONSIDERED NOT NEEDED IN THE IDEAL GYMNASIUM BY 46 ADMINISTRATORS OF SCHOOLS WITH POPULATIONS OF 400 TO 1,200 STUDENTS AND CORRESPONDING OPINIONS OF ARCHITECTS

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
Rhythm room	15.6	48.9	35.6	33.3	47.6	19.0
Work shop	20.0	37.8	42.2	5.6	5.6	88.9
First aid room, general	34.8	28.3	37.0	16.7	22.2	61.1
Shower room, mass, girls	43.5	19.6	37.0	52.6	21.1	26.3
Shower room, individual, boys	6.7	6.7	86.7	5.6	44.4	50.0
Squash courts	4.3	47.8	47.8	26.3	57.9	15.8
Staff office, men and women	25.0	17.5	57.5	26.3	26.3	47.4
Director's office plus staff office, men and women	17.5	30.0	52.5	0	36.8	63.2
Physical education staff office, men	47.7	18.2	34.1	5.3	52.6	42.1
Athletic staff office, ladies	11.6	27.9	60.5	60.5	20.0	15.0
Athletic head coach office, separate	14.0	41.9	44.2	36.8	21.1	42.1
Doctor's office	2.4	16.7	81.0	57.9	26.3	15.8
Nurses' office	36.4	15.9	47.7	36.8	36.8	26.3

Table XLVI (continued)

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
Dentist's office	2.4	14.3	83.3	55.0	25.0	20.0
Partition (folding) in classrooms	14.3	42.9	42.9	42.1	31.6	26.3
Partition (folding) in specialty room	11.9	52.4	35.7	0	42.1	57.9
Permanent seats in main gymnasium	15.0	10.0	75.0	78.9	15.8	5.3
Combination permanent and retractable seats in main gymnasium	20.5	23.1	56.4	5.3	36.8	57.8
Seven-foot constant depth pool	17.6	17.6	64.7	31.6	26.3	42.1
Four-foot constant depth pool	3.0	24.2	72.7	21.1	31.6	47.4
Diving pool	19.4	30.6	50.0	95.0	0	5.0

were considered as not needed by 50 per cent or more of the school administrators. Six of the components were considered not needed by 50 per cent or more of the architects. Ten of the components were rated as not needed in an ideal gymnasium by less than 33 per cent of the architects. Diving pools were considered to have been necessary to the ideal gymnasium by 95 per cent of the architects.

Large Schools

Table XLVII shows that 15 components were reported as not needed by more than 33 per cent of the administrators of schools with enrollments above 1,200. More than 50 per cent of the administrators considered 10 of the components as not needed in gymnasia.

More than 50 per cent of the architects reported that work shops and individual boys' shower rooms were not needed in gymnasia. Approximately 67 per cent of the architects considered that 10 of the components were either necessary or highly desirable in gymnasia.

IV. DIMENSIONS

The basic gymnasium floor was designed around a basketball court. Recommended dimensions of high school basketball courts are 50 feet by 84 feet.[1] The recommended safety space is 6 feet on each side and 8 feet on each end; the recommended basketball court dimensions, then, are 62 feet by 100 feet.[2] Twenty-two inches is the most commonly

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[1] *Planning Areas and Facilities for Health, Physical Education, and Recreation* (Chicago: The Athletic Institute; Washington, D.C.: American Association for Health, Physical Education, and Recreation, 1965), p. 85.

[2] *Ibid*, p. 91.

TABLE XLVII

GYMNASIUM COMPONENTS THAT WERE CONSIDERED NOT NEEDED IN THE IDEAL GYMNASIUM BY 34 ADMINISTRATORS OF SCHOOLS WITH POPULATIONS ABOVE 1,200 STUDENTS AND CORRESPONDING OPINIONS OF ARCHITECTS

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
Work shop	6.5	54.8	38.7	0	23.5	76.5
Shower rooms, individual, boys	6.3	15.6	78.1	0	41.2	58.8
Squash courts	0	45.5	54.5	27.8	61.1	11.1
Staff office, men and women	22.6	22.6	54.8	47.1	41.2	11.7
Director's office plus staff office, men and women	25.8	16.1	58.1	11.1	55.6	33.3
Individual offices	25.0	37.5	37.5	84.2	15.8	0
Athletic staff offices, ladies	18.7	21.9	59.4	72.2	27.8	0
Athletic head coach office, separate	18.2	42.4	39.4	47.1	35.3	17.6
Doctor's office	6.7	26.7	66.7	41.2	47.1	11.7
Nurses' office	35.5	22.6	41.9	52.6	31.6	15.8
Dentist's office	6.5	16.1	77.4	44.4	22.2	33.3
Permanent seats in main gymnasium	10.3	17.2	72.4	88.9	11.1	0

Table XLVII (continued)

COMPONENTS	PERCENTAGE OF ADMINISTRATORS			PERCENTAGE OF ARCHITECTS		
	necessary	desirable	not needed	necessary	desirable	not needed
Combination permanent and retractable seats in main gymnasium	40.0	13.3	46.7	5.6	50.0	44.4
Seven-foot constant depth pool	0	28.6	71.4	70.6	29.4	0
Four-foot constant depth pool	4.3	34.8	60.9	58.8	23.5	17.6

accepted depth for each row of folding bleachers.

According to Table XLVIII small schools lacked 5.45 feet (mean) of reaching the recommended length. A width of 28.15 feet (mean) remained for seating. The middle-sized schools had more than the recommended length and 34.09 feet (mean) extra width available for seating. The large schools also had more than the recommended length, or 58.76 feet (mean) available for main gymnasium flooring seating.

If the recommended 125 square feet[3] of usable activity space is available, a mean maximum class size of girls and boys for small schools would be 68.2 students. The mean class size for the schools was 40.2. Similarly, the middle-sized schools would have a mean maximum class size of 80. The mean class size for the middle-sized school was 56.85. The large school could have a mean maximum class size of 97.8 and still be within the recommendation. The mean class size for these schools was 84.37.

Approximately 12 to 15 square feet of space per student is recommended for dressing areas.[4] It was not always possible to distinguish between physical education dressing rooms and the athletic dressing rooms; therefore, there was no attempt to compare the available dressing area to the recommended dressing area. It appeared that the numbers of dressing rooms and square footage were directly proportional to the size of the school. The only exception to the above statement was that the larger schools had a lower mean number of girls' dressing rooms than did small and middle-sized schools.

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[3]Ibid, p. 90.

[4]Ibid, p. 97.

TABLE XLVIII

SUMMARY OF AVERAGE DIMENSION
OF GYMNASIUM AREAS ARRANGED ACCORDING
TO SCHOOL POPULATION GROUPS

AREA	SCHOOL POPULATION		
	below 400	400 - 1200	above 1200
Average main gym floor dimensions (feet)	90.2 x 94.6	96.1 x 103.9	101.2 x 120.8
Average foyer square footage	539.5	570.5	679.3
Average number of girls' dressing rooms	1.5	1.6	1.3
Average square feet in the girls' dressing rooms	754.1	1279.4	1495.3
Average number of boys' dressing rooms	1.8	2.1	2.8
Average square feet in the boys dressing rooms	1015.6	1617.1	2293.1
Average number of boys' shower rooms	1.75	1.61	1.82
Average square feet in boys' shower rooms	287.8	412.5	663.7
Average number of girls' shower rooms	1.6	1.6	2.2
Average square feet in the girls' shower rooms	270.5	384.2	500.4
Average square feet in the storage areas	724.9	1141.4	1214.1
Average number of offices	2.1	2.9	3.7
Average square feet in the offices	351.5	500.8	700.5
Average number of rest rooms	5.2	5.1	6.9
Average square feet in the rest rooms	427.9	633.7	912.1

The recommendations related to shower facilities were in terms of number of shower heads. It is recommended that shower areas be large enough to accommodate all students of one class or athletic event at the same time. The recommendation establishes the number of students for each shower head at approximately 4.[5] The number of shower heads was not indicated on many of the drawings; therefore, there was no comparison of the recommended with the actual shower heads. The number of shower rooms and square footage were directly proportional to the size of the schools. The only exception was that middle size schools had a lower mean number of boys' shower rooms than did small schools.

There was a definite indication of small rest rooms. Small school rest rooms average 83.1 square feet while middle-sized school rest rooms average 124.5 square feet. Rest rooms in large school gymnasia average 101.8 square feet.

---

[5] Ibid.

CHAPTER IX

SUMMARY

Each chapter of this study exhibited independence, therefore, each was concluded with a summary except Chapter VIII which was essentially a summary within itself. The objective of the chapter was to describe "typical" gymnasia according to the three school size groups.

There were some specifications that applied only to the gymnasia serving schools with student populations below 400. Others were descriptive of gymnasia serving schools with populations of 400 to 1,200 students, and still others applied to gymnasia serving schools with populations above 1,200 students. Certain specifications were descriptive of gynasia serving schools in each of the population groups. Chapter IX contains a summary of the specifications related to typical gymnasia as indicated by the data of this study.

I. SMALL SCHOOLS

Typical small school gymnasia were identified as follows.

<u>Main Gymnasium Area</u>

1. Area - 90.2 feet by 94.6 feet.
2. Heating - hot water fan coil unit heaters.
3. Ventilation - wall mounted exhaust fans.
4. Lighting - incandescent lamps.
5. Natural lighting - windows.
6. Flooring - hard maple.

7. Seating - folding bleachers or permanent seating

8. Operable partitions - none

<u>Dressing and Showering Facilities</u>

1. Girls' dressing rooms, number - 1.

2. Girls' dressing rooms, area - 754.1 square feet.

3. Girls' shower rooms - individual shower stalls with dressing cubicle or gang showers.

4. Girls' shower rooms, area - 270.5 square feet.

5. Boys' dressing rooms, number - 2.

6. Boys' dressing rooms, area - 1,015.6 square feet.

7. Dressing room floors - troweled concrete or quarry tile.

8. Boys' shower rooms, number - 2.

9. Boys' shower rooms, area - 287.8 square feet.

10. Shower room floors - ceramic tile.

11. Shower heads - conventional adjustable.

12. Lockers - two-tier metal lockers or wire baskets with clothing racks.

13. Athletic lockers - two-tier metal lockers.

14. Lighting - incandescent lamps.

15. Heating - hot water fan coil unit heaters.

<u>Classrooms</u>

1. Heating - finned-tubed convectors.

2. Flooring - asphalt tile.

3. Lighting - incandescent lamps.

4. Ventilation - windows.

Other Specifications

1. Foyer, area - 539.5 square feet.

2. Offices, number - 2.

3. Offices, area - 351.5 square feet.

4. Rest rooms, number - 5.

5. Rest rooms, area - 427.9 square feet.

II. MIDDLE-SIZED SCHOOLS

Typical middle-sized school gymnasia were identified as follows.

Main Gymnasium Area

1. Area - 96.1 feet by 103.9 feet.

2. Heating - hot water fan coil unit heaters.

3. Ventilation - wall mounted exhaust fans.

4. Lighting - incandescent lamps or mercury vapor lamps.

5. Natural lighting - none or windows.

6. Flooring - hard maple.

7. Seating - folding bleachers.

8. Operable partitions - fabric.

Dressing and Showering Facilities

1. Girls' dressing rooms, number - 2.

2. Girls' dressing rooms, area - 1,279.2 square feet.

3. Girls' shower rooms - individual shower stall with dressing cubicle or gang showers plus individual shower stall with dressing cubicle.

4. Girls' shower rooms, area - 484.2 square feet.

5. Boys' dressing rooms, number - 2.

6. Boys' dressing rooms, area - 1,617.1 square feet.

7. Dressing room floors - troweled concrete.

8. Boys' shower rooms, number - 2.

9. Boys' shower rooms, area - 412.5 square feet.

10. Shower room floors - ceramic tile.

11. Shower heads - conventional adjustable or fixed vandal-proof.

12. Lockers - two-tier metal lockers.

13. Athletic lockers - two-tier metal lockers or full length metal lockers.

14. Lighting - incandescent lamps.

15. Heating - hot water fan coil unit heaters or unit heater-ventilators.

Classrooms

1. Heating - finned-tubed convectors.

2. Flooring - vinyl tile.

3. Lighting - Fluorescent lamps.

4. Ventilation - windows.

Other Specifications

1. Foyer, area - 507.5 square feet.

2. Offices, number - 3.

3. Offices, area - 500.8 square feet.

4. Rest rooms, number - 5.

5. Rest rooms, area - 633.7 square feet.

III. LARGE SCHOOLS

Typical large school gymnasia were identified as follows.

Main Gymnasium Area

1. Area - 101.2 feet by 120.8 feet.
2. Heating - hot water fan coil unit heaters.
3. Ventilation - wall mounted exhaust fans or unit heater-ventilators.
4. Lighting - incandescent lamps.
5. Flooring - hard maple.
6. Natural lighting - none.
7. Seating - folding bleachers.
8. Operable partitions - fabric or folding

Dressing and Showering Facilities

1. Girls' dressing rooms, number - 1
2. Girls' dressing rooms, area - 1,495.3 square feet.
3. Girls' shower rooms - gang showers plus individual shower stalls with dressing cubicle or individual shower stalls with dressing cubicle.
4. Girls' shower rooms, area - 500.4 square feet.
5. Boys' dressing rooms, number - 3.
6. Boys' dressing rooms, area - 2,293.1 square feet.
7. Dressing room floors - troweled concrete or quarry tile.
8. Boys' shower rooms, number - 2.
9. Boys' shower rooms, area - 663.7 square feet.
10. Shower room floors, - ceramic tile.

11. Shower heads - fixed vandal-proof or conventional adjustable.

12. Lockers - two-tier metal lockers.

13. Athletic lockers - two-tier metal lockers or full-length metal lockers.

14. Lighting - fluorescent or incandescent lamps.

15. Heating - hot water unit heater-ventilators or fan coil unit heaters.

Classrooms

1. Heating - finned-tubed convectors.
2. Flooring - vinyl tile.
3. Lighting - fluorescent lamps.
4. Ventilation - windows.

Other Specifications

1. Foyer, area - 679.3 square feet.
2. Offices, number - 4.
3. Offices, area - 700.5 square feet.
4. Rest rooms, number - 7.
5. Rest rooms, area - 912.1 square feet.

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GYMNASIUM STUDY

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DEE I. GLUECK, A.I.A.

P. O. Box 2564.....Baton Rouge, Louisiana · 70801
Offices in the Reymond Building.....Phone 342-7503

Dear Architect:

We would like to write you a personal letter, but we are sure that you will understand the magnitude of such an endeavor when we say that there will be approximately 250 architects involved in this study.

Mr. Vane T. Wilson has embarked on a national study of gymnasia construction and use experiences with the encouragement of the Baton Rouge Chapter of the AIA (who assigned us to the project), the Louisiana State Superintendent of Education, the Louisiana State University College of Education, and many people who have been involved in planning the construction of a new gymnasium. More recently we have all been impressed with the tremendous support of 49 states and 4 U. S. possessions, including your Chief School Officer. We congratulate you for being selected to be a part of the study.

As an architect you will recognize the usefulness of such a broad reference of what has been done in all parts of the nation. We have worked with Mr. Wilson on the questionnaire, and we know he will appreciate your cooperation.

Sincerely yours,

EVANS & GLUECK
Architects

W. J. Evans

ARCHITECT QUESTIONNAIRE

FOR

A STUDY OF MATERIALS USED
IN THE CONSTRUCTION OF MODERN GYMNASIA

Dr. L. L. Fulmer, Dean
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Louisiana State University

The Honorable William J. Dodd
Superintendent of Education
State of Louisiana

Dr. Sam Adams
Professor of Education and
Director of the Study
Louisiana State University

Dr. William F. Beyer, Jr.
Assistant Superintendent
Division of Curriculum and Instruction
Louisiana Department of Education
Coordinator of the Study

Baton Rouge, Louisiana, Chapter
A.I.A.
Frank N. Brocato, President

Evans and Glueck Architects
A.I.A.
Cooperating Architects

Vane T. Wilson
Supervisor of Health and Physical Education
College of Education, Laboratory School
Louisiana State University
Researcher

PURPOSE

Your state coordinator, appointed by your Chief State School Officer, for our national survey of outstanding gymnasia has selected a gymnasium designed by you to be included in the study. We congratulate you on being selected.

This study is designed to furnish a broad reference of successful gymnasia materials and/or systems of materials to school people and architects who are planning to construct a new gymnasium. It is suggested that this study will be valuable in remodeling gymnasia, also.

OBJECTIVES

(1) To identify and describe present characteristics of materials and/or systems of materials used in modern gymnasium construction.

(2) To identify and describe the problems experienced in installing, using and maintaining the certain materials and/or systems of materials.

(3) To identify and describe the advantages in installing, using and maintaining the certain materials and/or systems of materials.

(4) To cluster or categorize costs of installing and maintaining the certain materials and/or systems of materials.

(5) To develop a checklist of gymnasium components categorized according to school population and climatic criteria.

(6) To develop a broad reference of successful gymnasia categorized according to school population and climatic criteria.

INSTRUCTIONS

(1) Much of the information included in this study will be furnished by your principal and by the U. S. Weather Bureau.

(2) The code number on your questionnaire will be used to identify your questionnaire and that of your principal.

(3) Certain of the questionnaire sections may not apply to your gymnasium. Please skip these sections.

(4) Specifications may be stated briefly. Examples: Wood strip flooring: 2nd grade Northern Hard Maple, on treated pine subflooring, on treated pine screeds, 18" centers; or, Suspended incandescent, equal to Miller AE3644, porcelain finish. Used 28 fixtures @ 750 watts, over playing courts.

(5) Detail sketches are asked for in certain areas. Please notice the instructions under the flap of the back cover.

(6) Spaces are provided for comments related to advantages and disadvantages. Feel free to make any brief comments that you feel are necessary.

(7) This questionnaire should be returned directly to the researcher. Please follow the instructions under the flap of the back cover.

(8) Your cooperation and participation in this research problem are sincerely appreciated. A copy of the final report will be sent to you.

Code________________

ARCHITECT'S QUESTIONNAIRE

____
Architect

____
Address

____
School

Heating, Dressing Rooms

Specifications________________________________

Circle the appropriate word.

A.	Cost as compared with others that are generally used.	Low	Average	High
B.	Cost of installation as compared with others that are generally used.	Low	Average	High
C.	Installation problems.	Simple	Average	Complex

Advantages (Other than those indicated above).

1.________________________________
2.________________________________
3.________________________________

Disadvantages (other than those indicated above).

1.________________________________
2.________________________________
3.________________________________

Heating, Main Gym Area

Specifications________________________________

Circle the appropriate word.

A.	Cost as compared with others that are generally used.	Low	Average	High
B.	Cost of installation as compared with others that are generally used.	Low	Average	High
C.	Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1.________________________________
2.________________________________
3.________________________________

Disadvantages (other than those indicated above).

1.________________________________
2.________________________________
3.________________________________

Code________________

Heating, Small Rooms

Specifications____

____

____

Circle the appropriate word.

A.	Cost as compared with others that are generally used.	Low	Average	High
B.	Cost of installation as compared with others that are generally used.	Low	Average	High
C.	Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Cooling, Air Conditioning

Specifications____

____

____

Circle the appropriate word.

A.	Cost as compared with others that are generally used.	Low	Average	High
B.	Cost of installation as compared with others that are generally used.	Low	Average	High
C.	Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Cooling, Fans

Specifications____

____

____

Circle the appropriate word.

A.	Cost as compared with others that are generally used.	Low	Average	High
B.	Cost of installation as compared with others that are generally used.	Low	Average	High
C.	Installation problems.	Simple	Average	Complex

Code________________

Cooling, Fans

Advantages (other than those indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Lighting, Dressing Rooms

Specifications____

____

____

Circle the appropriate word.

A.	Cost as compared with others that are generally used.	Low	Average	High
B.	Cost of installation as compared with others that are generally used.	Low	Average	High
C.	Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Lighting, Main Gym Area

Specifications____

____

____

Circle the appropriate word.

A.	Cost as compared with others that are generally used.	Low	Average	High
B.	Cost of installation as compared with others that are generally used.	Low	Average	High
C.	Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Code_______________

Lighting, Natural, Dressing Rooms

Specifications____

____

____

Circle the appropriate word.

A. Cost as compared with others that are generally used.	Low	Average	High
B. Cost of installation as compared with others that are generally used.	Low	Average	High
C. Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____

2.____

3.____

Disadvantages

1.____

2.____

3.____

Lighting, Natural, Main Gym

Specifications____

____

____

Circle the appropriate word.

A. Cost as compared with others that are generally used.	Low	Average	High
B. Cost of installation as compared with others that are generally used.	Low	Average	High
C. Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Lighting, Natural, Small Rooms

Specifications____

____

____

Circle the appropriate word.

A. Cost as compared with others that are generally used.	Low	Average	High
B. Cost of installation as compared with others that are generally used.	Low	Average	High
C. Installation problems.	Simple	Average	Complex

Code________________

Lighting, Natural, Small Rooms

Advantages (other than those indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Lighting, Small Rooms

Specifications____

____

____

Circle the appropriate word.

A.	Cost as compared with others that are generally used.	Low	Average	High
B.	Cost of installation as compared with others that are generally used.	Low	Average	High
C.	Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Dressing Facilities, Athletic Dressing Lockers

Specifications____

____

____

Circle the appropriate word.

A.	Cost as compared with others that are generally used.	Low	Average	High
B.	Cost of installation as compared with others that are generally used.	Low	Average	High
C.	Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Code______________

Dressing Facilities, Physical Education Dressing Lockers

Specifications____

____

____

Circle the appropriate word.

A. Cost as compared with others that are generally used.	Low	Average	High
B. Cost of installation as compared with others that are generally used.	Low	Average	High
C. Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Flooring, Apparatus Rooms

Specifications____

____

____

Please send a detail sheet if the floor design is significant.

Circle the appropriate word.

A. Cost as compared with others that are generally used	Low	Average	High
B. Cost of installation as compared with others that are generally used.	Low	Average	High
C. Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Flooring, Body Development Rooms (other than mats)

Specifications____

____

____

Please send a detail sheet if the floor design is significant.

Circle the appropriate word.

A. Cost as compared with others that are generally used	Low	Average	High
B. Cost of installation as compared with others that are generally used.	Low	Average	High
C. Installation problems.	Simple	Average	Complex

Code____________

Flooring, Body Development Rooms (other than mats)

Advantages (other than those indicated above).

1.____________

2.____________

3.____________

Disadvantages (other than those indicated above).

1.____________

2.____________

3.____________

Flooring, Classrooms

Specifications____________

Circle the appropriate word.

A. Cost as compared with others that are generally used.	Low	Average	High
B. Cost of installation as compared with others that are generally used.	Low	Average	High
C. Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____________

2.____________

3.____________

Disadvantages (other than those indicated above).

1.____________

2.____________

3.____________

Flooring, Games Rooms

Specifications____________

Please send a detail sheet if the floor design is significant.

Circle the appropriate word.

A. Cost as compared with others that are generally used.	Low	Average	High
B. Cost of installation as compared with others that are generally used.	Low	Average	High
C. Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____________

2.____________

3.____________

Disadvantages (other than those indicated above).

1.____________

2.____________

3.____________

Code________________

Flooring, Dressing Rooms

Specifications____

____

____

Circle the appropriate word.

A.	Cost as compared with others that are generally used.	Low	Average	High
B.	Cost of installation as compared with others that are generally used.	Low	Average	High
C.	Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Flooring, Main Gym

Specifications____

____

____

Please send a detail sheet.

Circle the appropriate word.

A.	Cost as compared with others that are generally used.	Low	Average	High
B.	Cost of installation as compared with others that are generally used.	Low	Average	High
C.	Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Flooring, Shower Rooms

Specifications____

____

____

Please send a detail sheet if the floor design is significant.

Circle the appropriate word.

A.	Cost as compared with others that are generally used.	Low	Average	High
B.	Cost of installation as compared with others that are generally used.	Low	Average	High
C.	Installation problems.	Simple	Average	Complex

Code ______________

Flooring, Shower Rooms

Advantages (other than those indicated above).

1. ______________

2. ______________

3. ______________

Disadvantages (other than those indicated above).

1. ______________

2. ______________

3. ______________

Seating, Main Gym Area

Specifications ______________

____

____

Circle the appropriate word.

A. Cost as compared with others that are generally used.	Low	Average	High
B. Cost of installation as compared with others that are generally used	Low	Average	High
C. Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1. ______________

2. ______________

3. ______________

Disadvantages (other than those indicated above).

1. ______________

2. ______________

3. ______________

Wall, Movable Partition, Main Gym

Specifications ______________

____

____

Circle the appropriate word.

A. Cost as compared with others that are generally used.	Low	Average	High
B. Cost of installation as compared with others that are generally used.	Low	Average	High
C. Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1. ______________

2. ______________

3. ______________

Disadvantages (other than those indicated above).

1. ______________

2. ______________

3. ______________

Code_______________

Walls, Movable Partition, Small Rooms

Specifications____

____

____

Circle the appropriate word.

A. Cost as compared with others that are generally used.	Low	Average	High
B. Cost of installation as compared with others that are generally used.	Low	Average	High
C. Installation problems.	Simple	Average	Complex

Advantages (other than indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Showering Facilities, Facilities for Girls

Specifications____

____

____

Circle the appropriate word.

A. Cost as compared with others that are generally used.	Low	Average	High
B. Cost of installation as compared with others that are generally used.	Low	Average	High
C. Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Showering Facilities, Showerheads

Specifications____

____

____

Circle the appropriate word.

A. Cost as compared with others that are generally used.	Low	Average	High
B. Cost of installation as compared with others that are generally used.	Low	Average	High
C. Installation problems.	Simple	Average	Complex

Code________________

Showering Facilities, Showerheads

Advantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Disadvantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Aquatics, Pool Walls

Specifications____________________

____

____

Circle the appropriate word.

A. Cost as compared with others that are generally used.	Low	Average	High
B. Cost of installation as compared with others that are generally used.	Low	Average	High
C. Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above)

1.____________________

2.____________________

3.____________________

Disadvantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Aquatics, Pool Floor

Specifications____________________

____

____

Circle the appropriate word.

A. Cost as compared with others that are generally used.	Low	Average	High
B. Cost of installation as compared with others that are generally used.	Low	Average	High
C. Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Disadvantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Code________________

Aquatics, Water Conditioning

Specifications____

____

____

Circle the appropriate word.

A.	Cost as compared with others that are generally used.	Low	Average	High
B.	Cost of installation as compared with others that are generally used.	Low	Average	High
C.	Installation problems.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Code__________________

Components of a Complete Gymnasium

Below is a listing of gymnasium components. Think of what you consider as a "complete" gymnasium for your school and those items that are <u>necessary</u> to make this "complete" gymnasium mark with "N". Those components that you believe are highly <u>desirable</u> but are <u>not required</u> mark "D". The items that are not needed mark "X".

ROOMS

___1. All rooms multi-purpose.
___2. Games rooms.
___3. Apparatus room.
___4. Classrooms, multi-purpose
___5. Classroom, boys.
___6. Classroom, girls.
___7. Classroom, health.
___8. Rhythm room.
___9. Wrestling room.
___10. Remedial or modified activity room.
___11. Athletic equipment storeroom, general, boys and girls.
___12. Athletic equipment storeroom, boys.
___13. Athletic equipment storeroom, girls.
___14. P.E. equipment storeooom, general, boys & girls.
___15. P.E. equipment storeroom, boys.
___16. P.E. equipment storeroom, girls.
___17. Heavy equipment storeroom (apparatus)
___18. Multi-purpose dressing room, boys.
___19. Multi-purpose dressing room, girls.
___20. Athletic dressing room, boys.
___21. Athletic dressing room, girls
___22. P.E. dressing room, boys.
___23. P.E. dressing room, girls
___24. Visual aids room.
___25. Janitor's equipment room.
___26. Field maintenance equipment storage.
___27. Work-shop (building & repair of equipment).
___28. First aid room, general.
___29. First aid room, boys.
___30. First aid room, girls.
___31. Shower room, mass, boys.
___32. Shower room, mass, girls.
___33. Shower rooms, individual, girls.
___34. Shower rooms, individual, boys.
___35. Foyer.
___36. Weight lifting room.
___37. Body development room.
___38. Concession room.
___39. Ticket sales' office.
___40. Multi-purpose restrooms, public & students.
___41. Public and student restrooms separate.
___42. Restrooms in the P.E. &/or athletic dressing rooms, girls.
___43. Restrooms in the P.E &/or athletic dressing rooms, boys.
___44. Conference rooms.
___45. Four-wall handball courts.
___46. Squash courts.

Code________

OFFICES

___1. A staff office, men and women.

___2. Ladies' staff office.

___3. Men's staff office.

___4. Director's office plus staff office, men and women.

___5. Director's office plus separate men and women staff offices.

___6. P.E. staff office, men.

___7. Individual offices.

___8. Athletic staff office, ladies.

___9. P.E. staff office, ladies.

___10. Separate athletic head coaches' offices.

___11. Athletic staff office, men.

___12. Doctor's office.

___13. Nurses' office.

___14. Staff showering facilities connected to offices.

___15. Dentist office.

___16. Staff toilet facilities connected to offices.

WALLS

___1. All unobstructed walls smooth for rebounding.

___2. Partition (folding) in main gym area.

___3. Partition (folding) in classrooms.

___4. Partition (folding) in specialty rooms.

SEATING

___1. Permanent seats in main gym.

___2. Retractable seats in main gym.

___3. Combination permanent and retractable seats in main gym.

POOLS

___1. Multi-purpose swimming pool.

___2. Seven-foot constant depth pool.

___3. Four-foot constant depth pool.

___4. Diving pool.

TO MAIL

(1) Open back flap.
(2) Fold back flap over front cover.
(3) Staple the address flap closed.
(4) Please send a floor plan (each level if multi-level).
(5) Please send the detail sketches as requested in the questionnaire. Note: If there are charges in printing the floor plan and the details, you may bill the researcher.
(6) Roll the prints in the usual method (please do not fold them because they will be photographed and returned to you).
(7) Include the questionnaire in the roll of prints.
(8) Place the address label on the print roll.
(9) If you do not send the prints, mail the questionnaire. All postage will be paid by the researcher.

APPENDIX C

FIRST CLASS
Permit No. 1223
Baton Rouge, La.

BUSINESS REPLY MAIL

No Postage Stamp Necessary If Mailed In The United States

Postage Will Be Paid By

Vane T. Wilson
L.S.U. Laboratory School
Baton Rouge, Louisiana 70803

SCHOOL QUESTIONNAIRE

FOR

A STUDY OF MATERIALS USED
IN THE CONSTRUCTION OF MODERN GYMNASIA

Dr. L. L. Fulmer, Dean
College of Education
Louisiana State University

The Honorable William J. Dodd
Superintendent of Education
State of Louisiana

Dr. Sam Adams
Professor of Education and
Director of the Study
Louisiana State University

Dr. William F. Beyer, Jr.
Assistant Superintendent
Division of Curriculum and Instruction
Louisiana Department of Education
Coordinator of the Study

Baton Rouge, Louisiana, Chapter
A.I.A.
Frank N. Brocato, President

Evans and Glueck Architects
A.I.A.
Cooperating Architects

Vane T. Wilson
Supervisor of Health and Physical Education
College of Education, Laboratory School
Louisiana State University
Researcher

PURPOSE

Your state coordinator, appointed by your Chief State School Officer, for our national survey of outstanding gymnasia has selected your gymnasium to be included in the study. We are proud to include you in this study. We congratulate you and your administration on being selected.

This study is designed to furnish a broad reference of successful gymnasia materials and/or systems of materials to school people and architects who are planning to construct a new gymnasium. It is suggested that this study will be valuable in remodeling gymnasia, also.

OBJECTIVES

(1) To identify and describe present characteristics of materials and/or systems of materials used in modern gymnasium construction.
(2) To identify and describe the problems experienced in installing, using and maintaining the certain materials and/or systems of materials.
(3) To identify and describe the advantages in installing, using and maintaining the certain materials and/or systems of materials.
(4) To cluster or categorize costs of installing and maintaining the certain materials and/or systems of materials.
(5) To develop a checklist of gymnasium components categorized according to school population and climatic criteria.
(6) To develop a broad reference of successful gymnasia categorized according to school population and climatic criteria.

INSTRUCTIONS

(1) Much of the information included in this study will be furnished by your architect and by the U.S. Weather Bureau.
(2) The code number on your questionnaire will be used to identify your questionnaire and that of your architects.
(3) You may not have comparable information available for certain of the questions, such as costs. Please answer these questions by expressing your opinion if comparisons are not available.
(4) Certain of the questionnaire sections may not apply to your gymnasium. Please skip these sections.
(5) Spaces are provided for any comments related to advantages and disadvantages of your facilities. Feel free to make any comments about your facilities that you feel are necessary.
(6) This questionnaire should be returned directly to the researcher Please follow the instructions under the flap of the back cover.
(7) Your cooperation and participation in this research problem are sincerely appreciated.

SUGGESTED PROCEDURE

(1) This is a staff study. The principal is the chairman.
(2) Call a fifteen minute meeting of your key staff members in physical education, athletics, custodial service, and maintenance.
- (a) Brief them on the questionnaire.
- (b) Ask them to give some thought to the gymnasium from the viewpoint of the questionnaire, including talking with other staff users of the gymnasium.
- (c) Set a staff study meeting approximately five days hence.

(3) At the staff study meeting each item should be answered by consensus with little, or no, debate.
- (a) All written comments should be brief.

SCHOOL QUESTIONNAIRE

Code__________

____
School

____
Address

Principal____________________ Architect____________________

Date the construction was accepted____________________

	Boys	Girls
School population	______	______
Average physical education class size	______	______
Average number of physical education classes per period	______	______

Heating, Dressing Rooms

Circle the appropriate word.

A. Usability.			
1. Does job.	Poor	Average	Excellent
2. Out of use (amount of time), break-down.	Little	Average	Large
B. Maintenance.			
1. Cost of maintenance.	Low	Average	High
2. Difficulty of maintenance	Simple	Average	Complex
3. Out of use (amount of time) for maintenance	Little	Average	Large
C. Operation.			
1. Cost of operation.	Low	Average	High
2. Ease of operation.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Disadvantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Code ____________

Heating, Main Gym Area

Circle the appropriate word.

A. Usability			
1. Does job.	Poor	Average	Excellent
2. Out of use (amount of time), break-down.	Little	Average	Large
B. Maintenance			
1. Cost of maintenance.	Low	Average	High
2. Difficulty of maintenance.	Simple	Average	Complex
3. Out of use (amount of time) for maintenance.	Little	Average	Large
C. Operation.			
1. Cost of operation.	Low	Average	High
2. Ease of operation.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Disadvantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Heating, Small Rooms

Circle the appropriate word.

A. Usability.			
1. Does job.	Poor	Average	Excellent
2. Out of use (amount of time), break-down.	Little	Average	Large
B. Maintenance.			
1. Cost of maintenance.	Low	Average	High
2. Difficulty of maintenance	Simple	Average	Complex
3. Out of use (amount of time) for maintenance	Little	Average	Large
C. Operation.			
1. Cost of operation.	Low	Average	High
2. Ease of operation.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Disadvantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Code_______________

Cooling, Air Conditioning

Circle the appropriate word.

A. Usability.

1. Does job.	Poor	Average	Excellent
2. Out of use (amount of time), break-down.	Little	Average	Large

B. Maintenance.

1. Cost of maintenance.	Low	Average	High
2. Difficulty of maintenance.	Simple	Average	Complex
3. Out of use (amount of time) for maintenance.	Little	Average	Large

C. Operation.

1. Cost of operation.	Low	Average	High
2. Ease of operation.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Disadvantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Cooling, Fans

Circle the appropriate word.

A. Usability.

1. Does job.	Poor	Average	Excellent
2. Out of use (amount of time) break-down.	Little	Average	Large

B. Maintenance.

1. Cost of maintenance.	Low	Average	High
2. Difficulty of maintenance.	Simple	Average	Complex
3. Out of use (amount of time) for maintenance.	Little	Average	Large

C. Operation.

1. Cost of operation.	Low	Average	High
2. Ease of operation.	Simple	Average	Complex

Advantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Disadvantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Code_______________

Lighting, Dressing Rooms

Circle the appropriate word.

A. Usability.

1. Does job.	Poor	Average	Excellent
2. Out of use (amount of time), breakage.	Little	Average	Large

B. Maintenance.

1. Cost of maintenance.	Low	Average	High
2. Difficulty of maintenance.	Simple	Average	Complex

C. Operation.

1. Cost of operation.	Low	Average	High

D. Use.

1. Average number of days used (per week)_______________

2. Natural light available (on normal days)	None	Insufficient	Sufficient

Advantages (other than those indicated above).

1._______________

2._______________

3._______________

Disadvantages (other than those indicated above).

1._______________

2._______________

3._______________

Lighting, Main Gym Area

Circle the appropriate word.

A. Usability.

1. Does job.	Poor	Average	Excellent
2. Out of use (amount of time), breakage.	Little	Average	Large

k. Maintenance

1. Cost of maintenance.	Low	Average	High
2. Difficulty of maintenance.	Simple	Average	Complex

C. Operation.

1. Cost of operation.	Low	Average	High

D. Use.

1. Average number of days used (per week)_______________

2. Natural light available (on normal days).	None	Insufficient	Sufficient

Advantages (other than those indicated above).

1._______________

2._______________

3._______________

Disadvantages (other than those indicated above).

1._______________

2._______________

3._______________

Code________________

Lighting, Shower Rooms

Circle the appropriate word.

A. Usability.

1. Does job.	Poor	Average	Excellent
2. Out of use (amount of time), breakage	Little	Average	Large

B. Maintenance.

1. Cost of maintenance.	Low	Average	High
2. Difficulty of maintenance.	Simple	Average	Complex

C. Operation.

1. Cost of operation.	Low	Average	High

D. Use.

1. Average number of days used (per week)________________

Advantages (other than those indicated above).

1.________________
2.________________
3.________________

Disadvantages (other than those indicated above).

1.________________
2.________________
3.________________

Lighting, Small Rooms

Circle the appropriate word.

A. Usability.

1. Does job.	Poor	Average	Excellent
2. Out of use (amount of time), breakage.	Little	Average	Large

B. Maintenance.

1. Cost of maintenance.	Low	Average	High
2. Difficulty of maintenance.	Simple	Average	Complex

C. Operation.

1. Cost of operation.	Low	Average	High

D. Use.

1. Average number of days used (per week)________________

2. Natural light available (on normal days).	None	Insufficient	Sufficient

Advantages (other than those indicated above).

1.________________
2.________________
3.________________

Disadvantages (other than those indicated above).

1.________________
2.________________
3.________________

Code ______________

Lighting, Natural Lighting

Check.

A. Kinds available.

1. Windows	2. Glass brick.	3. Sky lights.
a. Dressing rooms___	a. Dressing rooms___	a. Dressing rooms___
b. Main gym___	b. Main gym___	b. Main gym___
c. Small rooms___	c. Small rooms ___	c. Small rooms____

Circle the appropriate word.

A. Usability.

1. Does job.	Poor	Average	Excellent
2. Breakage	Little	Average	Large
3. Requires masking.			
a. Dressing rooms.	None	Some	Completely
b. Main gym	None	Some	Completely
c. Small rooms	None	Some	Completely

Advantages (other than those indicated above).

1. ____
2. ____
3. ____

Disadvantages (other than those indicated above).

1. ____
2. ____
3. ____

Dressing Facilities, Athletic Dressing Lockers

Circle the appropriate word.

A. Usability.			
1. Does job.	Poor	Average	Excellent
2. Out of use (number of units), breakage.	Some	Average	Excessive
3. Ventilation.	Poor	Average	Excellent
A. Difficulty			
1. Difficulty of maintenance.	Simple	Average	Complex
C. Operation (if there are working parts).			
1. Ease of operation.	Simple	Average	Complex

D. Use.

1. Average number of persons using single unit each day. 1 2 3 4 5 6
2. Lock used. Yes No

Advantages (other than those indicated above).

1. ____
2. ____
3. ____

Disadvantages (other than those indicated above).

1. ____
2. ____
3. ____

Code ________________

Dressing Facilities, Physical Education Dressing Lockers

Circle the appropriate word.

A. Usability.

1. Does job.	Poor	Average	Excellent
2. Out of use (number of units), breakage.	Some	Average	Excellent
3. Ventilation.	Poor	Average	Excellent

B. Maintenance.

1. Difficulty of maintenance.	Simple	Average	Complex

C. Operation (if there are working parts).

1. Ease of operation.	Simple	Average	Complex

D. Use.

1. Average number of persons using single unit each day. 1 2 3 4 5 6

2. Locks are used. Yes No

Advantages (other than those indicated above).

1. ______________________________

2. ______________________________

3. ______________________________

Disadvantages (other than those indicated above).

1. ______________________________

2. ______________________________

3. ______________________________

Flooring, Apparatus Rooms

Circle the appropriate word.

A. Usability.

1. Does job.	Poor	Average	Excellent

B. Maintenance

1. Cost of maintenance.	Low	Average	High
2. Difficulty of maintenance.	Simple	Average	Complex
3. Out of use (amount of time) for maintenance.	Little	Average	Large

C. Characteristics related to standing, walking, running, and jumping.

1. Soft. 2. Medium. 3. Hard.

D. Use.

1. Estimated number of days used per year for classes__________.

2. Estimated number of days used per year other than for classes ______

Advantages (other than those indicated above).

1. ______________________________

2. ______________________________

3. ______________________________

Disadvantages (other than those indicated above).

1. ______________________________

2. ______________________________

3. ______________________________

Code________________

Flooring, Body Development Rooms (other than mats)

Circle the appropriate word.

A. Usability.

1. Does job. Poor Average Excellent

B. Maintenance.

1. Cost of maintenance. Low Average High

2. Difficulty of maintenance. Simple Average Complex

3. Out of use (amount of time) for maintenance. Little Average Large

C. Characteristics related to standing, walking, running, and jumping.

1. Soft. 2. Medium. 3. Hard.

D. Use

1. Estimated number of days used per year for classes ___________.

2. Estimated number of days used per year other than for classes_____.

Advantages (other than those indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Flooring, Classrooms

Circle the appropriate word.

A. Usability.

1. Does job. Poor Average Excellent

B. Maintenance.

1. Cost of maintenance. Low Average High

2. Difficulty of maintenance. Simple Average Complex

3. Out of use (amount of time) for maintenance. Little Average Large

C. Characteristics related to standing, walking, running, and jumping.

1. Soft. 2. Medium. 3. Hard.

D. Estimated number of days used per year for classes____________________.

Advantages(other than those indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Code________________

Flooring, Games Rooms

Circle the appropriate word.

A. Usability.

1. Does job.	Poor	Average	Excellent

B. Maintenance.

1. Cost of maintenance.	Low	Average	High
2. Difficulty of maintenance.	Simple	Average	Complex
3. Out of use (amount of time) for maintenance.	Little	Average	Large

C. Characteristics related to standing, walking, running, and jumping.

1. Soft. 2. Medium. 3. Hard.

D. Use.

1. Estimated number of days used per year____________.

Advantages (other than those indicated above).

1.______________________________

2.______________________________

3.______________________________

Disadvantages (other than those indicated above).

1.______________________________

2.______________________________

3.______________________________

Flooring, Main Gym

Circle the appropriate word.

A. Usability.

1. Does job.	Poor	Average	Excellent

B. Maintenance.

1. Cost of maintenance.	Low	Average	High
2. Difficulty of maintenance.	Simple	Average	Complex
3. Out of use (amount of time) for maintenance.	Little	Average	Large

C. Characteristics related to standing, walking, running, and jumping.

1. Soft. 2. Medium. 3. Hard.

D. Use.

1. Estimated number of days used per year for classes____________.
2. Estimated number of days used per year other than for classes______. (Note: Athletics are considered as other than classes).
3. When not in scheduled use (impromptu, noon, between classes, etc.), traffic is — Light — Medium — Heavy

Advantages (other than those indicated above).

1.______________________________

2.______________________________

3.______________________________

Disadvantages (other than those indicated above).

1.______________________________

2.______________________________

3.______________________________

Code________________

Flooring, Dressing Rooms

Circle the appropriate word.

A. Usability.

1. Does job.	Poor	Average	Excellent

B. Maintenance.

1. Cost of maintenance.	Low	Average	High
2. Difficulty of maintenance.	Simple	Average	Complex
3. Out of use (amount of time) for maintenance.	Little	Average	Large

C. Characteristics when wet.

1. Slick. 2. Good traction.

D. Use.

1. Estimated number of days used per year for classes____________.

Advantages (other than those indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Flooring, Shower Rooms

Circle the appropriate word.

A. Usability.

1. Does job.	Poor	Average	Excellent

B. Maintenance.

1. Cost of maintenance.	Low	Average	High
2. Difficulty of maintenance.	Simple	Average	Complex
3. Out of use (amount of time) for maintenance or repair.	Little	Average	Large

C. Characteristics when wet.

1. Slick. 2. Good traction.

Advantages (other than those indicated above).

1.____

2.____

3.____

Disadvantages (other than those indicated above).

1.____

2.____

3.____

Code ______________

Seating, Main Gym Area

Circle the appropriate word.

A. Usability.

1. Does job.	Poor	Average	Excellent
2. Out of use (amount of time), breakage	None	Little	Large

B. Maintenance.

1. Cost of maintenance.	None	Little	High
2. Difficulty of maintenance.	None	Little	Complex

C. Operation (if movable).

1. Ease of operation.	Simple	Average	Hard

D. Use.

1. Average number of times moved (per week)____________________.

Advantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Disadvantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Movable Partition Wall, Main Gym

Circle the appropriate word.

A. Usability.

1. Does job.	Poor	Average	Excellent
2. Out of use (amount of time), breakage.	None	Little	Large

B. Maintenance.

1. Cost of maintenance.	Low	Average	High
2. Difficulty of maintenance.	None	Little	Complex

C. Operation.

1. Ease of operation.	Simple	Average	Hard

D. Use.

1. Average number of times moved (per week)____________________

Advantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Disadvantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Code________________

Movable Partition Walls, Small Rooms

Circle the appropriate word.

A. Usability.

1. Does job.	Poor	Average	Excellent
2. Out of use (amount of time), breakage.	None	Little	Large

B. Maintenance.

1. Cost of maintenance.	Low	Average	High
2. Difficulty of maintenance.	Simple	Average	Complex

C. Operation.

1. Ease of operation.	Simple	Average	Hard

D. Use.

1. Average number of times moved (per week)____________________.

Advantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Disadvantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Showering Facilities, Facilities for Girls

Circle the appropriate word.

A. Usability.

1. Does job.	Poor	Average	Excellent

B. Maintenance.

1. Difficulty of maintenance.	Simple	Average	Complex
2. Out of use (amount of time) for maintenance.	Little	Average	Large

C. Use.

1. Estimated number of days used per year____________________.

Advantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Disadvantages (other than those indicated above).

1.____________________

2.____________________

3.____________________

Code________________

Showering Facilities, Showerheads

Circle the appropriate word.

A. Usability.

1. Does job.	Poor	Average	Excellent

B. Maintenance.

1. Difficulty of maintenance.	Simple	Average	Complex
2. Out of use (amount of time) for maintenance.	Little	Average	Large

Advantages (other than those indicated above).

1.______________________________

2.______________________________

3.______________________________

Disadvantages (other than those indicated above).

1.______________________________

2.______________________________

3.______________________________

Aquatics, Pool Walls

Circle the appropriate word.

A. Usability.

1. Does job.	Poor	Average	Excellent

B. Maintenance.

1. Seepage problem	None	Little	Serious
2. Ease in cleaning	Simple	Average	Hard

C. Use.

1. Estimated number of times pool is drained and refilled (per year)____.
2. No water in pool.
   1. Never (except for cleaning). 2. Short periods. 3. Extended periods.

Pool Floor

A. Maintenance.

1. Seepage problem.	None	Little	Serious
2. Ease in cleaning.	Simple	Average	Hard

Water Conditioning

A. Usability.

1. Does job.	Poor	Average	Excellent
2. Out of use (Amount of time) breakage.	Little	Average	Large

B. Maintenance.

1. Cost of charging.	Low	Average	High
2. Difficulty of maintenance.	Simple	Average	Complex

C. Operation.

1. Ease of operation.	Simple	Average	Hard

Comments: (relate to the success, or lack of success, of your aquatic facilities.)

Code__________________

Components of a Complete Gymnasium

Below is a listing of gymnasium components. Think of what you consider as a "complete" gymnasium for your school and those items that are necessary to make this "complete" gymnasium mark with "N". Those components that you believe are highly desirable but are not required mark "D". The items that are not needed mark "X".

ROOMS

___1. All rooms multi-purpose.

___2. Games rooms.

___3. Apparatus room.

___4. Classrooms, multi-purpose

___5. Classroom, boys.

___6. Classroom, girls.

___7. Classroom, health.

___8. Rhythm room.

___9. Wrestling room.

___10. Remedial or modified activity room.

___11. Athletic equipment storeroom, general, boys and girls.

___12. Athletic equipment storeroom, boys.

___13. Athletic equipment storeroom, girls.

___14. P.E. equipment storeooom, general, boys & girls.

___15. P.E. equipment storeroom, boys.

___16. P.E. equipment storeroom, girls.

___17. Heavy equipment storeroom (apparatus)

___18. Multi-purpose dressing room, boys.

___19. Multi-purpose dressing room, girls.

___20. Athletic dressing room, boys.

___21. Athletic dressing room, girls

___22. P.E. dressing room, boys.

___23. P.E. dressing room, girls

___24. Visual aids room.

___25. Janitor's equipment room.

___26. Field maintenance equipment storage.

___27. Work-shop (building & repair of equipment).

___28. First aid room, general.

___29. First aid room, boys.

___30. First aid room, girls.

___31. Shower room, mass, boys.

___32. Shower room, mass, girls.

___33. Shower rooms, individual, girls.

___34. Shower rooms, individual, boys.

___35. Foyer.

___36. Weight lifting room.

___37. Body development room.

___38. Concession room.

___39. Ticket sales office.

___40. Multi-purpose restrooms, public & students.

___41. Public and student restrooms separate.

___42. Restrooms in the P.E. &/or athletic dressing rooms, girls.

___43. Restrooms in the P.E &/or athletic dressing rooms, boys.

___44. Conference rooms.

___45. Four-wall handball courts.

___46. Squash courts.

Code ________________

OFFICES

____1. A staff office, men and women.

____2. Ladies' staff office.

____3. Men's staff office.

____4. Director's office plus staff office, men and women.

____5. Director's office plus separate men and women staff offices.

____6. P.E. staff office, men.

____7. Individual offices.

____8. Athletic staff office, ladies.

____9. P.E. staff office, ladies.

____10. Separate athletic head coaches' offices.

____11. Athletic staff office, men.

____12. Doctor's office.

____13. Nurses' office.

____14. Staff showering facilities connected to offices.

____15. Dentist office.

____16. Staff toilet facilities connected to offices.

WALLS

____1. All unobstructed walls smooth for rebounding.

____2. Partition (folding) in main gym area.

____3. Partition (folding) in classrooms.

____4. Partition (folding) in specialty rooms.

SEATING

____1. Permanent seats in main gym.

____2. Retractable seats in main gym.

____3. Combination permanent and retractable seats in main gym.

POOLS

____1. Multi-purpose swimming pool.

____2. Seven-foot constant depth pool.

____3. Four-foot constant depth pool.

____4. Diving pool.

TO MAIL

(1) Open back flap.
(2) Fold back flap over front cover.
(3) Staple the address flap closed.

VITA

Vane Thomas Wilson, son of Thomas Walter and Hattie Bruce Wilson, was born in North Little Rock, Arkansas on July 6, 1919.

Elementary schools attended were in North Little Rock, Arkansas, and high school graduation was from North Little Rock Senior High School in January, 1938. He attended Arkansas State Teachers College, Conway, Arkansas, from January, 1938, to January, 1941. He received his Bachelor of Science Degree from Louisiana State University in 1947 and the Master of Science Degree from Louisiana State University in 1948.

For a period of five years, 1941 - 1946, he served in the United States Air Force and attained the rank of Lieutenant Colonel.

His professional experiences included: Counselor of Athletes, Louisiana State University, 1946 - 1948; Math-science teacher and coach, Destrehan High School, 1948 - 1952; Assistant football coach, University of Arizona, 1952; teacher of physical education and coach, Destrehan High School, 1952 - 1955; supervisor of physical education and coach, Louisiana State University Laboratory School, 1955 - 1966. In 1966 he was appointed Assistant Principal of Louisiana State University Laboratory School, the position presently held.

He was married on August 14, 1948, to Miss Zoe Ellen Sandras. Their daughter was born December 18, 1953. Their present home is in Baton Rouge, Louisiana.

EXAMINATION AND THESIS REPORT

Candidate: Vane Thomas Wilson

Major Field: Education

Title of Thesis: A Study of Materials Used in the Construction of Modern Gymnasia

Approved:

Sam Adams
Major Professor and Chairman

Max Goodrich
Dean of the Graduate School

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Date of Examination:

April 7, 1967